NEW ZEALAND GEOGRAPHER

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The aims of the Society as stated in the constitution are 'to promote and stimulate the study of geography'. These are the aims of more than one Society in the world and the New Zealand Geographical Society is particularly concerned with geography in New Zealand. It is therefore the Society's policy to stimulate geographic studies of New Zealand and matters closely related to the dominion.

The Society undertakes the publication of a journal, the *New Zealand Geographer*, and of a *Record* of its proceedings, both of which at present appear twice a year. Branches of the Society organise lectures, study groups, and excursions, and encourage their members to prepare matter for publication in the *New Zealand Geographer*. Contributions from overseas writers and those who are not members of the Society are also encouraged.

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THE FISHING INDUSTRY OF NEW ZEALAND

P. D. DIBBLE

THE PRESENT SCOPE and future potentialities of the fishing industry in New Zealand is a matter of active discussion and widespread speculation. Its many problems present a challenge to scientists in general. The geographer's broad survey and regional interests may contribute to their solution.

An American geographer, Donald Patton,[1] has already briefly surveyed some of the general characteristics of the dominion's fishing grounds and has delineated the principal areas of fishing activity; but most important, he has pointed out the place of the New Zealand industry in the world setting.

The annual landing of approximately 21,000 tons of wet fish,[2] although small in comparison with the landings of Great Britain (1,082,000 tons in 1947) and the United States (2,166,000 tons in 1947),[3] is sufficient to supply the dominion's present somewhat small needs and still leave a surplus for export. In fact, the catch expressed in pounds of fish per head of population is relatively high. In New Zealand it is 27.8 lb. per annum, whilst in the United States and Great Britain the figures are 36.7 lb. and 50.6 lb. respectively. Average consumption has been estimated as only seven ounces per head per week,[4] or twenty-two pounds a year, so that about one quarter of the total landings are available for export, mainly to Australia. In 1951 marine food to the value of £1,400,000 was landed, but its retail market value was considerably in excess of this figure. The total manpower involved, even indirectly, was no more than 5000 persons, comprising less than one percent of the national labour force. But with the export market realising over £1,000,000, of which some £600,000 is obtained from dollar areas, the industry is becoming increasingly important and prosperous.

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[1] D. Patton: 'New Zealand Fisheries: A General Survey', *N.Z. Geographer*, Vol. 8, No. 2, October 1952, pp. 91-103.

[2] Wet fish comprises the fish species but does not include crustaceans or molluscs.

[3] F. B. Shorland: 'The Aquatic Animal Oil Resources in New Zealand', *N.Z. Journ. Sci. & Tech.*, Vol. 32B, No. 2, September 1950, p. 2, Table I.

[4] *Report of the Sea Fisheries Investigation Committee*, Wellington, 1938, p. 3.

FISHING GROUNDS

The benefit derived from the dominion's long coastline is nullified to a great extent by the narrow nature of the insular shelf, which has been estimated to average only twenty-five miles in width.[5] Added to this is the great disadvantage of a lack of 'banks'—relatively flat areas overlain by shallow water, which are so valuable to the fisheries of the northern hemisphere as feeding and spawning grounds. Yet perhaps the major characteristic of the fishing industry in New Zealand is the marked differentiation that exists between the fish resources and fishing activity off the east and west coasts.

As a result of adverse weather conditions off the west coast, fishing activity has always been greatest on east coast grounds and relatively little attention has been paid to those off the western coasts. In 1953, however, increased fishing activity by vessels based on the port of Onehunga raised the annual landings for the Manukau fishery district from 2459 cwt. in 1952 to 25,266 cwt., thus casting doubt on the generally accepted theory that western grounds lacked adequate fish stocks. Moreover, the west coast of the South Island now provides New Zealand's largest landings of crayfish. Bluff (36,391 cwt.) and Greymouth (6794 cwt.) account for the largest totals for any port, while vessels from Dunedin and even Christchurch find the long haul to the Fiordland grounds more than profitable. Yet the lack of good all-weather harbours seriously hampers west-coast fishermen; and the prevailing westerly weather, coupled with a lack of shelter, greatly reduces the number of fishing days in the year. Furthermore, west-coast fishermen are restricted in the range of their activities by bar-bound harbours which rapidly become unnavigable in bad weather. Governmental regulations which forbid the landing of fish at any place other than the port of registry also restrict fishing off the west coasts. Finally, the distribution of population has hitherto precluded the establishment of a large enough fleet of big all-weather vessels capable of exploiting efficiently the resources of west-coast waters.[6]

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[5] Patton: *op. cit.,* p. 96.

[6] The Manukau district is the one exception. Here close proximity to the large Auckland market has provided the necessary stimulus.

The east coast, on the other hand, has the advantage of large feeding and spawning grounds, a considerable share of the insular shelf, better all-weather harbours, and shelter provided by coastal ranges and islands from westerly weather. The dominion's large urban markets are also situated to the east. As a result ninety-five percent of the total catch is landed at east coast and Cook Strait ports. Even on the east coast,

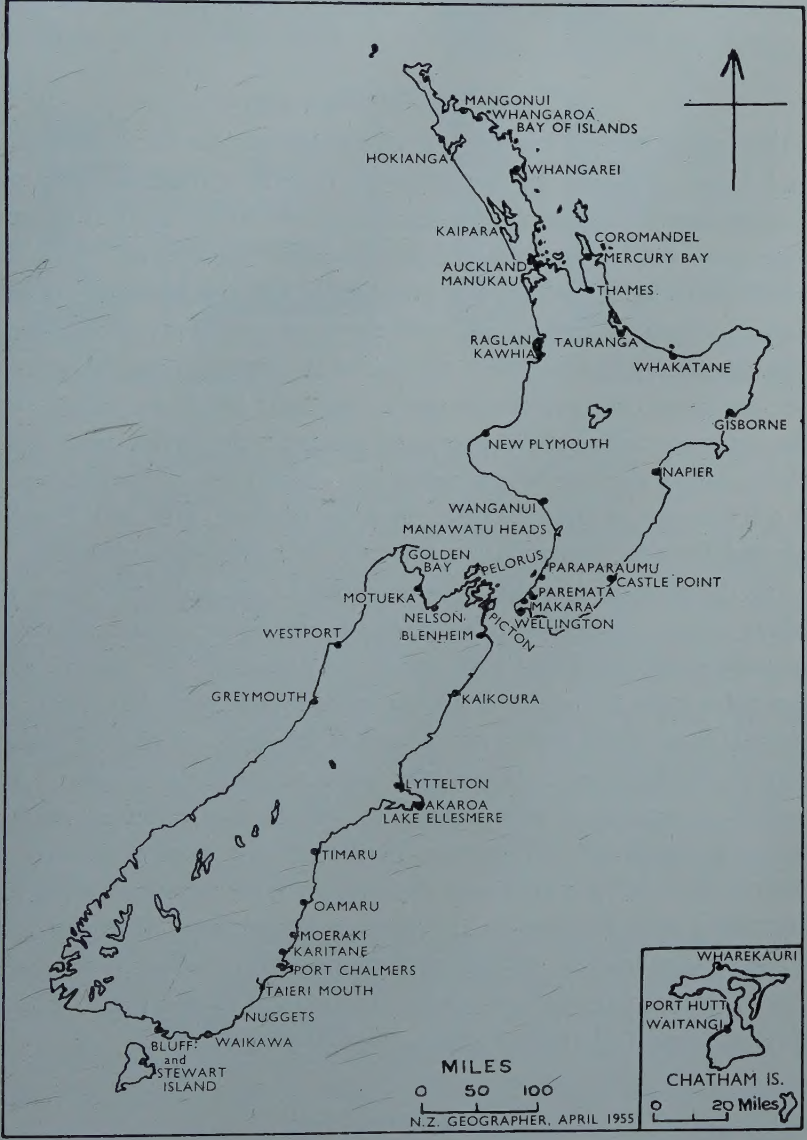

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Fig. 1. Fishing ports and districts of New Zealand.

however, weather makes its influence felt and the number of fishing days decreases from north to south. The North Island claims sixty-three percent of the total landings of wet fish in the dominion, the South Island thirty-five percent, and the Chatham Islands the remainder (*Figs.* 2 and 3).

FISH SPECIES

The second major characteristic of the industry in New Zealand is that, despite the great variety of species caught in relation to the size of catch, emphasis is on the production of two major species: snapper (*Pagrosomus autatus*) and tarakihi (*Dactylopagrus macropterus*) which together make up over half the total catch. Of the hundreds of fish species in New Zealand waters, only forty are caught on a commercial scale. Barely one half of these are landed in quantities exceeding 1000 cwt. per annum and only seven species regularly yield over 10,000 cwt. The extent to which the commercial market is dependent upon these seven main species can be seen when it is realised that of the total catch of 408,858 cwt. in 1952, tarakihi, snapper, gurnard, blue cod, hapuka, sole and flounder provided 341,800 cwt. or eighty-three percent.[7]

The distribution of species can be assessed only indirectly from the fishing returns of individual boats; but as certain areas, particularly on the west coast, are fished only lightly or not at all, the picture even then is far from complete. A further limitation of such data is that the regional taste of the public has a marked influence on the fish sought after by the fishermen. This further tends to mask the picture. Until recently tarakihi was very difficult to sell on the Auckland market, while the dislike of Wellington housewives for snapper persists. In general, however, it may be said that snapper is the principal fish landed from Nelson to Kaipara on the west coast and from Whangaroa to Whakatane on the east; tarakihi predominates from Gisborne to Christchurch; gurnard is chiefly landed at Timaru and Napier; sole at Dunedin; and blue cod at Bluff and in the Chatham Islands.

FISHING PERSONNEL

Although approximately 5000 persons are dependent in some degree on the fishing industry, only 2400 are directly dependent on marine harvests. In 1953 licensed fishermen numbered 2680 but only 1537

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[7] 118,675 cwt.; 97,320 cwt.; 32,457 cwt.; 31,378 cwt.; 28,157 cwt.; 20,942 cwt.; and 12,871 cwt. respectively in 1952.

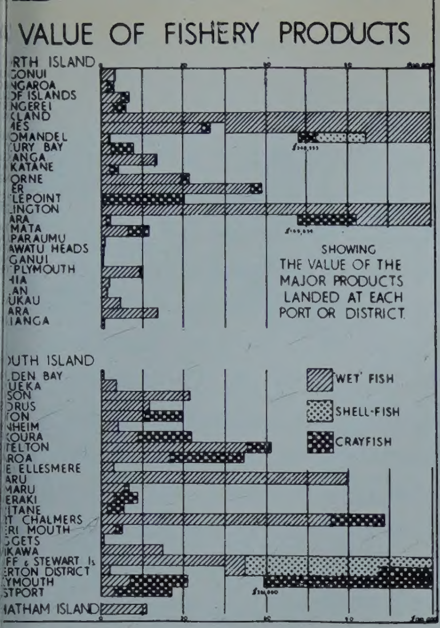

Fig. 2. Value of fishery products landed.

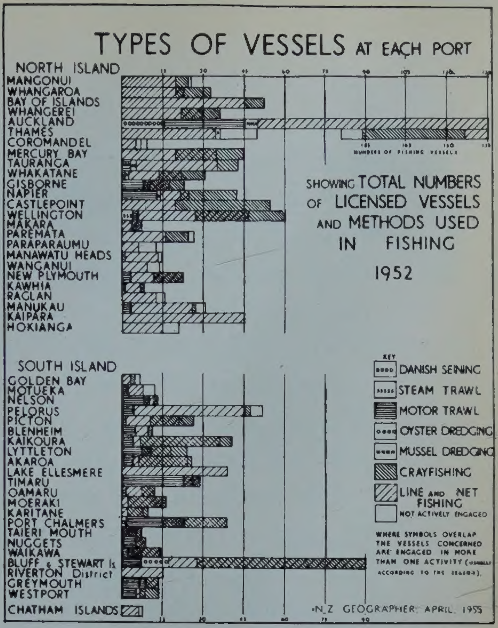

Fig. 3. Types of vessels and methods used.

worked on vessels the value of whose catch for the year exceeded £200 and could therefore be considered as being occupied full-time. The remaining fishermen work only spasmodically, or in specialised seasonal activities, and they may be regarded as part-time operators. Although both classes of fishermen are to be found in all but three[8] of the dominion's forty-eight ports, 923 of the 1150 part-time fishermen are to be found in the North Island, many of them on the west coast. In the north the bigger markets, good weather and many sheltered bays have encouraged the casual fisherman, while in the south the influence of the weather cuts down fishing time, discouraging part-time fishermen. Even with a greater proportion of full-time manpower[9] and a larger trawling fleet, the South Island produces only one third of the national catch.

One significant feature of employment in fishing is the wide variety of ethnic groups engaged and their concentration in certain small areas. Peoples traditionally associated with the sea have migrated to New Zealand in the past and their descendants still form the nucleus of the fishing industry. In the Auckland provincial district the descendants of the early Dalmatian gumdiggers have often taken to fishing, so that today they comprise almost four-fifths of the personnel. Greeks and Italians have a similar hold in the Wellington area, the latter especially in the Picton whaling industry, while peoples of British stock, mainly Scots and English, form the bulk of South Island fishermen. The Maori, although an expert fisherman, has not taken to commercial fishing as would perhaps be expected, possibly because he has traditionally taken only what his family group requires and naturally dislikes large-scale commercial exploitation of natural resources. There are numerous exceptions to this rule, however, especially in North Auckland, the Waikato and East Cape where oysters, whitebait and crayfish respectively are exploited during the season by the local Maori population.

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[8] The Chatham Islands have no part-time fishermen, Nuggets and Wanganui no full-time fishermen.

[9] Fifty-two percent of the manpower in the North Island is occupied full-time, forty-eight percent in the South Island.

The distribution of employment is based primarily on the location of ports in relation to available markets and fishing resources. As a result the east coasts claim sixty percent of all commercial fishermen, the west coasts fifteen percent[10] and the ports of Cook and Foveaux Straits the remainder. However, the actual production of each port does not necessarily reflect the total number of licensed fishermen but rather the distribution of full-time employment in fishing.

The Fishing Fleet

In 1952 1161 boats were engaged in fishing for wet fish, the great majority being motor-powered. Although vessels using power netting techniques[11] accounted for only eighteen percent of the above total, they landed over seventy-three percent of the total catch, clearly illustrating the great reliance the industry places on this method of capture. Despite the obvious efficiency of these vessels their total numbers are small (only 213), being limited by the cost of equipment (£7000 and over), the species of demersal or pelagic fish available, and the nature of the fishing grounds within reasonable distance of the port of landing.[12]

The two principal methods involved in power netting are either steam or diesel motor trawls and Danish seine nets. This latter method is rapidly giving way to the former because of the high operating costs involved.[13] The remaining two methods of fish capture are lines and set nets and, although operating costs are low, this is offset by the fact that catches are relatively small. Thus both of these methods tend to be used in seaweed and rocky channels where trawling is unsuitable.

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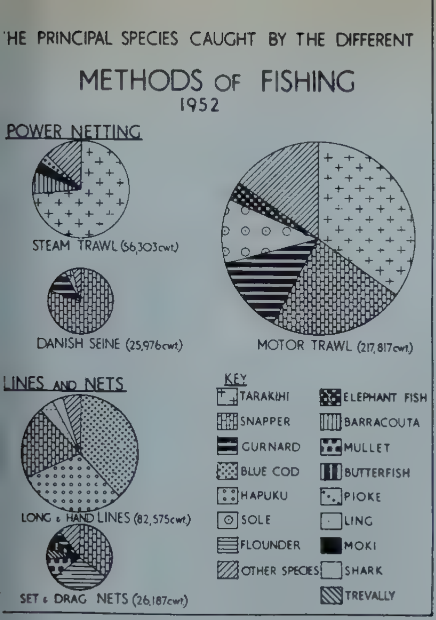
[10] Although some 3800 persons were occupied part-time in the whitebait fishing in 1950 (1730 in Westland) no licence was required and thus these men are not classed as commercial fishermen.

[11] Steam and motor trawls and Danish seine nets.

[12] Power nets are unsuitable for use where the bottom is 'foul'—that is, rocky and uneven.

[13] Seine boats use seven hundred-foot coils of two and a half inch fibre rope which last only six weeks and cost several hundred pounds. Trawlers use steel warps lasting as much as a year.



ig. 4. Fish species and the methods of capture.

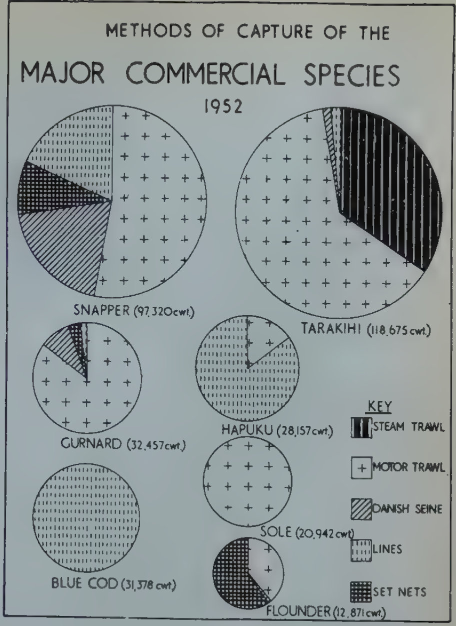


Fig. 5. Methods of capture and species caught.

In quantity of fish caught, trawl methods are most important since they account for two-thirds of the 1952 total. Steam trawlers, which are ocean-going steel vessels, landed 13.8 percent, mainly tarakihi, and these ships now operate solely from Wellington. Motor trawlers, smaller wooden diesel-engined craft, landed fifty-three percent—tarakihi, gurnard, sole and snapper—while Danish seine-net boats landed 6.35 percent, four-fifths of which was snapper. The catch of set nets—snapper and flounder—has declined greatly as a result of competition from trawlers, but line fishing for blue cod and hapuka, which are not caught by other methods, accounts for over one fifth of the national catch (*Figs.* 4 and 5).

Baited pots have traditionally been the accepted method of taking crayfish, but in recent years the greater part of the catch has been captured in the nets of trawlers as the crayfish move into the coast to breed.

In 1952 only forty percent of the 1422 licensed boats landed a catch for the year exceeding £200 in value. Most vessels work only spasmodically or not at all. The importance of the 'regular'[14] boats in the total landings is great, however, for the 484 vessels so defined (one third of the total fleet)[15] working from the twelve major ports, landed eighty-three percent of the dominion's catch.[16] Although the North Island has nearly twice as many licensed vessels as the South Island, most of these are used by part-time fishermen, and more boats operate regularly in the south where bad weather discourages part-time operators. On the west coast, too, a relatively large number of boats are based, but these vessels produce only five percent of the total catch, and only seventy-three are regular fishing boats.[17]

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[14] Those earning over £200 per annum.

[15] 215 of these regular vessels were trawlers.

One of the most striking characteristics exhibited by the dominion's fishing fleet is the versatility of methods and catch. More than one quarter of the fleet serves in more than one capacity according to the season and the weather,[18] and as a result of the handsome profits gained from the export of crayfish tails to the American market, many line and net boats, and even trawlers when they can profitably work their gear, journey to the crayfish grounds to reap the harvest.

Markets

One of the gravest problems at present facing the industry is that of disposing of the catch. Ports with large local markets capable of being served by non-refrigerated road transport are moderately well-off in this respect and any surplus can usually be packed for export. The smaller ports, however, find it difficult to meet the high cartage costs of long-distance transport to urban markets, and thus their output is often restricted. At present fish is despatched to inland towns only by rail, and because of the unsatisfactory nature of the facilities available, sales in such towns are not large. The scattered nature of settlement and the absence of a comprehensive rail network, especially in the North Island, make for difficulties in inland marketing.

As a result of limited markets, inadequate transport and seasonal fluctuations in catch, an export trade has been developed to market surpluses, although the nearest large market is over 1200 miles away. Difficulty is often experienced in obtaining refrigerated shipping space, supply tends to be uneven in New Zealand, and recently English and South African competition at cheaper prices has hindered development. Australia takes virtually all the dominion's export of frozen fish

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[16] Auckland 112,626 cwt.; Wellington 55,282 cwt.; Port Chalmers 31,968 cwt.; Napier 24,574 cwt.; Timaru 24,365 cwt.; Bluff 17,567 cwt.; Lyttelton 14,509 cwt.; Nelson 13,900 cwt.; Gisborne 13,666 cwt.; Chatham Islands 11,366 cwt.; Thames 11,212 cwt.; Tauranga 10,369 cwt.

[17] Only twenty-two trawlers operated from west-coast ports in 1952. In 1953 eleven trawlers changed from the Auckland to the Manukau district and thus increased this number.

[18] Vessels must carry a separate licence for each method of fishing used, and gear for one method only can be carried at one time.

—49,500 cwt., yielding over £350,000 in 1952. Small quantities only are sent to the Pacific Islands. No difficulty is experienced in selling crayfish to the North American market, however, and this export has been growing steadily since 1947. In 1953 eighty-three percent of crayfish landings were exported in the form of frozen tails,[19] mainly to the United States, yielding £695,063 in revenue (*Fig*. 6).

Owing to the form of export 'packs' (mainly fillets) the wastage from frozen fish is very large, and the 49,770 cwt. exported in 1952 represents 100,000 cwt. of 'green fish'[20] (one quarter of the total catch), and such are the profits from the export trade that the industry today has become very dependent upon it.

SECONDARY INDUSTRIES

Apart from the export of surplus marine products, there have recently grown up subsidiary industries utilising specialised products and waste. The most significant of these are canning factories, fertiliser works, and liver and whale oil plants.

Canneries are to be found in each of the four main centres[21] although fish products often form an insignificant part of their output; but in several instances considerable production is maintained in remote ports and districts by small factories utilising local products.[22] Factories canning only fish, on the other hand, are now a feature only of Bluff where 120,000 lb. of 'deep-sea pike' (barracouta) were canned in 1952. The lack of cheap fish in reliable quantities elsewhere presents serious problems. A relatively new development has been the establishment of treatment plants for utilising fish waste to produce stock food and fertiliser. Approximately 8000 tons of waste and offal are produced annually, and until recently this was dumped in the sea, thus polluting the seabed. Today, processing plants at Auckland, Tauranga, Gisborne, Napier, Christchurch and Dunedin are in operation, and another is proposed for Wellington.

The processing of aquatic animal oils has been an industry of long standing in New Zealand, the whalers and sealers being the first Europeans to settle these shores. Today a highly mechanised whaling industry is still operating. A recently developed activity—processing edible fish livers for oil—already surpasses whaling in value of output. Two plants are at present operating, one at Auckland utilising all livers taken north of New Plymouth and Napier, and the other in Wellington processing the remainder. The small school shark (*Galeorhinus australis*) is the main source of liver, but ling, groper, and even big-game fish livers are also

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[19] The tail represents approximately one quarter the weight of the crayfish and much of the remainder is wasted.

[20] Green fish is fish straight from the sea.

[21] Oyster canning is important in Dunedin and Bluff.

[22] For example: Te Kopuru (toheroas), Te Kohanga (whitebait), Coromandel (mussels), and Okuru (whitebait).

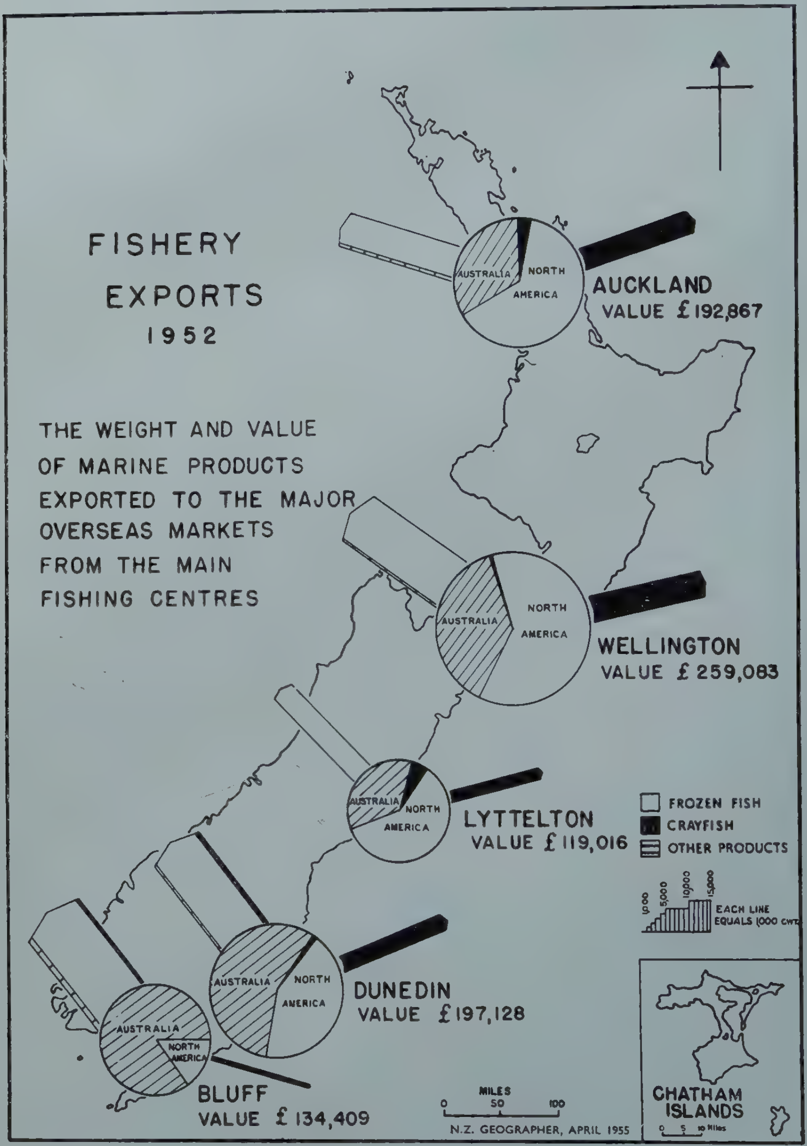


Fig. 6. Exports of fishery products, 1952.

used. In 1952 over 800,000 lb. of liver were processed to yield 39,275 gallons of oil, eighty percent of which was exported.

The whaling station situated in Tory Channel, Picton, is essentially a shore-based activity relying on the annual northward migration of whales through Cook Strait during the short season from May to August. Four chasers are engaged in hunting the quarry and the mother ship *Tuatea* is used to haul the 'kill' back to the shore plant for flensing and digesting. In 1952, 800 tons of oil worth £40,000, and 110 tons of bone dust, were extracted from the 122 whales captured, and the meat was sold for dog and poultry food in Nelson and Marlborough.

Regional Aspects

From even a cursory study of New Zealand fisheries, a clear distinction early becomes apparent between the east and west coasts and between the north and the south. Regional characteristics spring largely from the influence of weather on fishing operations, but transport facilities, markets, population and the nature of fishing grounds also contribute. More than four-fifths of the dominion's fishing vessels and manpower are directed upon east coast grounds which realise ninety-five percent of the total catch by weight and ninety percent by value. Between north and south a similar distinction appears, and in 1952, northern ports landed sixty-three percent of the national catch, and southern ports only 34.5 percent, despite the fact that fishing grounds in the south could well be termed 'underfished'. These differences are reinforced by differences in the number and types of vessels in full-time and part-time employment, in the ethnic groups concerned, and in fish species landed. The seven major species are found on both coasts but there are definite latitudinal limits to snapper (south to Cook Strait), tarakihi (north to Coromandel on the east), blue cod and sole (north to Cook Strait), and gurnard (south to Port Chalmers). Among the shell fisheries, dredge oysters are confined to Foveaux Strait, and mussels and rock oysters to the north of East Cape.

Although north-south and, to a certain extent, east-west divisions are basic features of New Zealand fisheries, ten smaller fishery regions can be purposefully recognised based on the characteristics of fishing operations and markets (*Fig.* 7).

Northland and Auckland

The region including, and north of, the Kaipara Harbour is characterised by its narrow peninsular form and the consequent intimate interrelations between land and sea. Nowhere is the land more than twenty-five miles from the sea. Here 260 licensed fishermen work 210 vessels landing £50,000 worth of marine products. Maoris and Dalmatians, mostly part-time fishermen, work small line and set-net vessels catching snapper, shark, flounder and mullet. This area is the principal supplier of rock oysters and toheroas, and crayfish are also captured. With no large overseas port, however, the region looks south to Auckland for its market surpluses, to process livers, and to export canned toheroa.

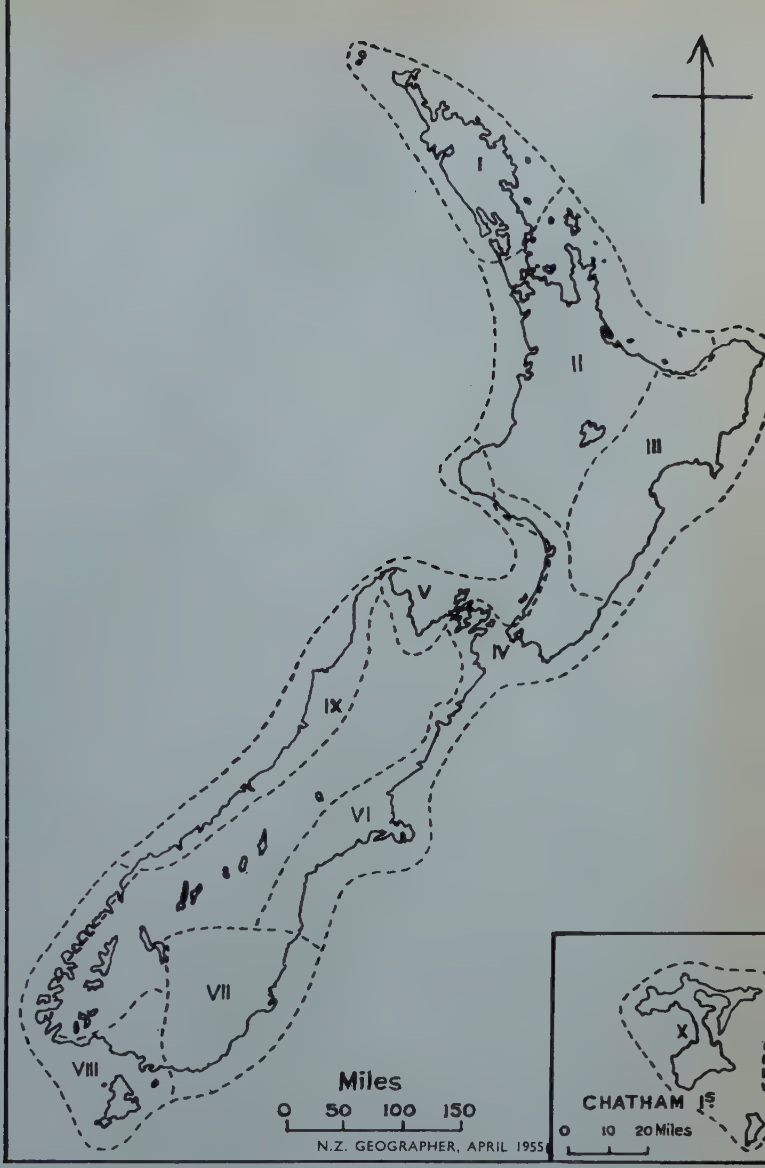
In range of vessels, manpower, catch, markets and fleet Auckland (including the Hauraki Gulf and the Bay of Plenty) is supreme. The whole gamut of fishery activities, except whales and commercial toheroa production, is included, and the range and diversity of production within this area is only exceeded by the range and diversity of its external markets. There are three major ports: Auckland (112,626 cwt.), Thames (11,212 cwt.) and Tauranga (10,369 cwt.); and in 1952 production reached thirty-five percent of the national total. Here one quarter of the dominion's fishermen, four-fifths of them Dalmatians, and one quarter of the fishing fleet, fifty trawlers among them, operate, working grounds from East Cape around North Cape to New Plymouth. Snapper and tarakihi comprise eighty percent of the region's wet-fish catch, and mussels, rock oysters and crayfish, as well as whitebait from the Waikato River, are also produced in significant quantities. With canning, fertiliser, fish-meal and liver-oil industries distributed throughout the area Auckland is the 'complete' fishery region.

THE EAST COAST

As Gisborne and Napier, the only two ports on the east coast of the North Island south of East Cape, are both major fishing centres on a New Zealand scale, a large catch is landed in relation to the size of the local population, and over half of the catch travels overland to markets in the Bay of Plenty, Wairarapa, Manawatu and Taranaki. Some crayfish is caught off East Cape but tarakihi and, to a lesser extent, gurnard form the basis of the fishery. Although only twenty-eight of the fleet of sixty-three vessels worked regularly in 1952, twenty-three were motor trawlers netting large returns, and the majority of fishermen worked full-time.

COOK STRAIT AND THE TARANAKI BIGHT

Dominated by Wellington which produces eighty-two percent of the catch, and has the only steam-trawl fleet in the dominion, the



N.Z. GEOGRAPHER, APRIL 1955

7. Fishery regions of New Zealand.

Northland
Auckland
East Coast
Cook Strait
Taranaki Bight
Canterbury
Otago
Bluff and Stewart Island
West Coast
Chatham Islands

environs of Cook Strait are the focus of tarakihi and hapuka fishing, and the site of New Zealand's only whaling station. The relatively large catch of this region, combined with a small hinterland, has enabled Wellington to build up the largest export trade in the dominion, 17,530 cwt. of marine products valued at £259,000 being sent to Australia and North America in 1952.[23] The region is centrally situated on good deep-water grounds between the two islands and it has built up an unusual fishery using a combination of equipment—steam trawl, lines, crayfish pots and whale chasers. This combination is not found elsewhere in the dominion.

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[23] 10,000 cwt. of blue cod is received from the Chatham Islands each year, and much of the surplus snapper from Nelson is exported through Wellington.

Although Nelson, which lands 13,900 cwt., is the only major port within the region dependent upon the resources of the waters of Taranaki Bight, it is not a focus. The whaling industry, for example, looks rather to Wellington. However, the fishing here is based on snapper rather than on tarakihi, and differences in fishing techniques and fish species, both within this area and the surrounding regions, set it off as a region distinct from Cook Strait and Wellington.[24]

Canterbury and Otago

North and south of Banks Peninsula no one species predominates and gurnard, tarakihi, elephant fish, ling, hapuka, flounder and sole provide a wide range of marketable species. Crayfish are important, particularly at Akaroa and Kaikoura, but there is a complete absence of shellfish. Motor trawling is the most important technique used, and seventy percent of all vessels work full-time. Because the relatively large occupied hinterland of the Canterbury Plains affords a considerable market within easy access, seventy percent of the fish landed at Lyttelton and Timaru is consumed locally, leaving only a small surplus for export.

Although the region from Oamaru to Waikawa has a large hinterland, the small scattered markets consume little of the catch and half is exported, making Dunedin second only to Wellington as an export centre. In Port Chalmers, the major port of the region, motor trawlers land most of the catch of sole and tarakihi, but in the adjacent smaller ports, line vessels landing blue cod and hapuka are important. Processing industries in the area include oyster canning[25] and fish-fertiliser manufactures. With the development of the west-coast crayfishery, boats now regularly make the trip to Fiordland, and as a result, wet-fish returns are falling.

Bluff and Stewart Island

The Bluff fishery is unique. Only three types of fish are produced but these are in such quantity that their value (£284,169 in 1952) rivalled that of the landings in Auckland. Dredge oysters, of which 93,676 sacks were landed, are found only in this region, and the crayfish landings of 16,186 cwt. were double that of any other region. Blue cod, which totalled 16,828 cwt. in 1952, is the only fish caught in any quantity. Trawling here is insignificant, lines taking ninety-seven percent of wet fish. As the local market is so small, Bluff has become principally a producer for export and, in the case of dredge oysters, is the sole supplier of the national market.

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[24] The motor trawl is not used in Wellington, and butterfish, flounder and trevally are not landed at Wellington in any quantity.

[25] The oysters come from Bluff.

West Coast and the Chathams

Although the west coast of the South Island can boast only two small ports, Greymouth (2259 cwt.) and Westport (1379 cwt.), poor harbours, some of the worst weather in New Zealand, and the smallest catch of fish for any region, it is nevertheless a rich fishery, realising £107,792 in 1952. Crayfish valued at £44,000 and whitebait at £50,343 provide the reason, and these products are railed and even flown out for export or for sale on the east coasts. Because of the small local population, the catch of 3638 cwt. of wet fish is sufficient and the fishery continues to prosper.

In the Chatham Islands, situated 422 miles southeast of Wellington, a total of only eight line vessels fishing for blue cod and hapuka produce 11,366 cwt. of fish from almost virgin grounds. With a local population of only 520 inhabitants there is little scope for internal marketing and practically all the fish caught is frozen and shipped to Wellington. Such is the wealth of the cod grounds that little fishing is done until the supply boat is due to arrive to pick up the catch, and then a full load of fish can be caught in two or three days. This fits in with the fisher-farmer economy of the islands, however, and it is a notable feature that no fish are landed during November or December because of shearing operations. The Chathams constitute the dominion's smallest fishery in size and value (£16,388), but it is nevertheless a very rich one, and the catch per boat and per man is larger than in any other region.

Conclusions

Although the annual production from New Zealand fisheries is small on a world scale, local demand is also modest, so that up to one quarter of the total catch can be sent overseas. So valuable has this export trade become that in 1952 fishery products sold abroad realised half as much again as the landed value of the products.

As a result of the policy of conservation applied by the Marine Department to the heavily-fished grounds of the east coast, the present output seems relatively secure; and, with the greater pressure on west coast grounds, landings can be increased. Improved transport facilities to both home and overseas markets will increase sales, but high costs and lack of popular species will probably prevent a great expansion of the fish-canning industry in New Zealand.

The replacement of old trawlers by modern vessels complete with two-way radio and echo-sounding devices is improving the range and efficiency of the fleet, and an equivalent number of vessels now produce 75.47 percent of the total catch as against 68.76 percent in 1947. Overall production has not yet regained the peak of 1949 but can be increased by fishing in the deeper parts of the insular shelf. This, however, will tend to increase operating costs and, also, retail prices.

With the export market meeting increased competition there is need to enlarge sales on the home market. To increase public interest, marketing costs will have to be reduced, a more attractive product promoted and a more speedy and efficient transport system evolved. The fishing industry is at present by no means fully developed. Deep-water resources have still be to investigated, and more use must be made of west-coast and southern grounds, at present largely neglected, if production is to be noticeably increased.

NEW ZEALAND LANDFORMS*

WILLIAM H. WALLACE

THE PURPOSE of this paper is to apply to the description of the landforms of New Zealand an approach which has greater significance to the field of geography than the 'traditional' explanatory description made familiar by Davis and Cotton.[1] This is in no sense an attack upon geology or upon the genetic study of landforms. A full geographical study of landforms should include a consideration of the inherent character, the origin, and the significance to areal differentiation of this group of phenomena. This is a call for an examination of the adequacy for geography of a geomorphology that is too preoccupied with genesis to consider adequately the present character of the earth's surface.[2]

An Objective Approach

Although the specific methods employed in this paper may be unfamiliar, it would be quite incorrect to consider this approach as a fundamentally new way of regarding surface configuration.[3] It is, in fact, the very oldest. The objective method was the first which men, geographers or otherwise, employed in their considerations of landforms. Ample evidence of this is available in the simple, unsophisticated generic terms like plain, hill, and mountain, which have been in constant use since human speech began. All peoples have developed such words and concepts. In recent times increased cultural interchange has brought many terms of non-English origin into the vocabulary, and these enable terrain to be described with greater precision. These 'newer' words were usually employed to characterise landforms which were not found in the British Isles: fiord, plateau, canyon.

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* The writer wishes to acknowledge his indebtedness to Professor Edwin H. Hammond of the University of Wisconsin for his criticism of this paper and the classification of landforms which it presents. Credit is also due the postgraduate students at Auckland University College who provided much of the basic data used in this landform analysis.

[1] W. M. Davis: *Geographical Essays,* Boston, 1909; C. A. Cotton: 'Geomorphic Provinces in New Zealand', *N.Z. Geographer,* Vol. 1, No. 1, April 1945, pp. 40-47.

[2] For an extreme example of this deficiency, see the map 'Plains of the North Island' in P. Marshall: *The Geography of New Zealand,* Christchurch, 1911, p. 120. Any similarity between the Wanganui Coastal Plain of Marshall and the surface configuration which is generally associated with plains is very difficult to discover!

[3] In this paper the terms 'landforms', 'surface configuration' and 'terrain' are used synonymously.

Classical geographers, including Ritter and von Humboldt,[4] also considered surface configuration objectively. It was during the late nineteenth century marriage of the discipline with geology that the genetic approach to landforms entered geography. It is not surprising that modern geography, which so often had its academic origins as an offshoot of geology, adopted the methods of this science for use in the analogous branch of its own field. However, the geographer need not adhere to this tradition if his knowledge may be advanced more effectively by the development of ideas which differ from those of the geologist.

Geologists and genetic geomorphologists have evolved concepts which are suited to their concern with the earth body and earth processes as primary objects of study. This aim has led them to consider the evolution of landforms and to formulate generic concepts useful for that purpose. But this interest is quite different from that of the geographer, who studies the areal differentiation of the world. Indeed, terrain characteristics that are of major importance to an understanding of landform origin, such as striations or the distribution of particular groups of boulders, may have little, if any, significance in the total geography of an area.

Significance of Present Character

In analysing landforms a geographer must ascertain those aspects which are of greatest significance to the problems of his discipline. The pertinent question is: What characteristics of terrain are causally related to other phenomena in this or other areas? The interconnection between landforms and the total geography of any place is almost always through their *present character* rather than through their genesis.

The vegetation of the Southern Alps is related to their elevation, aspect and slopes, and to their location and orientation with respect to the general atmospheric circulation. Elevation affects both temperature and precipitation, and thus also vegetation. Aspect is significant to vegetative character through its effect upon insolation and upon the incidence of various types of weather. Slope has direct significance to vegetation because the force of gravity prohibits the growth of many plants on very steep faces. Slope also has relation to vegetation through its influence upon soil character, runoff and insolation. Location and orientation relative to the atmospheric circulation is fundamental in determining the types of air masses which come into contact with the ranges, and hence their climate and vegetative cover. In contrast, direct interconnection between the genesis of these ranges and the present geography of the South Island remains to be demonstrated.

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[4] Particularly interesting is Ritter's landform classification described in R. E. Dickinson and O. J. R. Howarth: *The Making of Geography*, Oxford, 1933, pp. 156–158.

The sinuous route patterns, numerous tunnels, bridges and severe gradients of roads and railways in inland Taranaki are causally related to the prevalence of steep slopes, the general absence of flat land and the depth of dissection which characterise the terrain of this area. High construction costs and the prevalence of slips in wet weather reflect these same features and also the soft material which composes the landforms of inland Taranaki. It is even possible to demonstrate indirect connection between the surface configuration of this district and the light local traffic on the carriers which serve it. But only through these end-products is there connection between the lines of transport and the evolution of this terrain from a now vanished uplifted plain.

The intensive pastoral farming of the Hauraki Plains is aided by the prevalence of gentle slopes which are not conducive to erosion and by surface material of fine texture. On the other hand, the lack of relief and poor natural drainage in this area present problems which have required expensive solutions. Location close to well-drained hill country permits the use of 'run-off' pastures by stock during periods of excessively wet weather on these plains. All of these geographically significant interrelations involve inherent characteristics of the present terrain. On the other hand, it is very difficult to establish direct causal relations between characteristics of the farming in this district and the formation of these plains by sedimentation in a graben between mountain masses.

Inadequacy of Genetic Geomorphology

The conviction that the primary geographic significance of landforms lies in their present character rather than their genesis is by no means unique.[5] As the scope and knowledge of the field have grown many students have realised that genetic geomorphology by itself does not serve adequately as a systematic branch of geography. In many cases it fails to provide the generic concepts of greatest use to the rest of the discipline. This dissatisfaction is evidenced by the objective landform analyses of Passarge in Germany,[6] and of Smith, Raisz, Hammond and others in the United States.[7] The work of Cumberland and others is indicative of a similar trend in this country.[8]

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[5] See, for example, R. Hartshorne: 'The Nature of Geography', *Annals Assoc. Amer. Geogrs.*, Vol. 29, 1939, pp. 388-391; and *idem: Geographic Study of Landforms*, unpublished outline, Department of Geography, University of Wisconsin, Madison, 1950.

Generic concepts and the classifications which express them must be significant for the purpose at hand. If the aims of geography do not coincide with those of genetic geomorphology, it is not only permissible, but necessary, that new concepts be developed suited to its own particular aims—appropriate to an understanding of the areal differentiation of the earth.

Classifications and Generic Concepts

The objective description of landforms is by no means a simple task. A primary concern with surface configuration does not mean that the problems involved are either 'superficial' or easy. On the contrary, the inherent complexity of the phenomena presents a large number of difficulties. However, as in climate, soils and other branches of geography, understanding and the ability to develop generic concepts may be facilitated by the use of systematic classifications. In this paper a landform classification derived from that of Hammond[9] is applied to New Zealand. Primarily because Hammond's scheme was devised for use on land masses one hundred times as large, with quite different characteristics, certain modifications have been made to fit the classification to New Zealand. Differences in the availability and reliability of information have necessitated a simplification and change in emphasis among the criteria to permit uniform application to all parts of this country.

Any classification presupposes individuals or units which are grouped to form classes. If one is concerned with people, plants, or animals the individuals are defined by nature. Climate, soils, and landforms present more difficult problems because they are not composed of natural units. In climatic classifications the individuals classified are climatic conditions at specific points as revealed by the reports of weather stations. Terrain, however, is an areal concept, and 'point' values do not give a meaningful sample of conditions over a large area even where they are available. The work of Smith,[10] Hammond[11] and others indicates that the degree of subjectivity is least, and the possibility for consistent uniform application is greatest, if arbitrarily delimited and uniform small areas of terrain are employed as individuals for purposes of classification. These areas should be of a size sufficient to give a good sample of the terrain, including both ridge tops and adjacent valley bottoms. It has been found that a square five thousand yards on each side gives a good approximation to these conditions in most parts of New Zealand, and units of this size form the individuals in the classification described below. Such units have an extent roughly half that of the seven and one-half minute rectangles used by Hammond, and this is in keeping with the 'scale' of landforms and the juxtaposition of diverse types of terrain common in New Zealand.

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[6] S. Passarge: *Beschreibende Landschaftskunde,* Hamburg, 1929, pp. 10-55.

[7] G. H. Smith: 'The Relative Relief of Ohio', *Geogr. Rev.,* Vol. 25, 1935, pp. 272-284; E. Raisz: 'An Average Slope Map of Southern New England', *ibid.,* Vol. 27, 1937, pp. 467-472; and E. H. Hammond: 'Small-Scale Continental Landform Maps', *Annals Assoc. Amer. Geogrs.,* Vol. 44, 1954, pp. 33-42.

[8] See K. B. Cumberland: *Soil Erosion in New Zealand,* Christchurch, 1944; and contributions of various authors in the series, 'Geographic Regions of New Zealand', in the *Post-Primary School Bulletin,* Vol. 4, No. 4, 1950, to Vol. 7, No. 1, 1953 (*passim*).

[9] Hammond: *op. cit.*

A study of the inherent characteristics of landforms involves other problems which are analogous to those encountered in the description of climate. Both are really complexes, not solitary phenomena, and consequently it is necessary to reduce them to component characteristics if they are to be analysed and compared. Geographers have often called such characteristics 'elements', and just as climate may be expressed in terms of elements like temperature and precipitation, so it is also possible to describe landforms by means of a system of elements.

ELEMENTS OF LANDFORM CLASSIFICATION

The question then arises as to what elements are useful for an objective description of terrain. Relief, areal extent, slope, pattern and profile are but a few. However, any classification that aims to facilitate, rather than to complicate description, must be relatively simple. This is particularly important if the groupings are to be represented on small-scale maps. Consequently, the classification which forms the basis of the accompanying maps (*Figs.* 1, 2 and 3) is based upon three differentiating characteristics only.

The first of these is *local relief*—the maximum difference in elevation within the five thousand yard squares used in this terrain analysis. This measure tells us the 'scale' of the terrain—the height of the hills or the depth of the valleys. In addition, it is the terrain characteristic for which reliable data are most widely and uniformly available. It forms the primary differentiating characteristic of the classification presented here. Six classes are defined on the basis of local relief: *A*, less than 100 feet; *B*, between 100 and 300 feet; *C*, between 300 and 600 feet; *D*, between 600 and 1000 feet; *E*, between 1000 and 3000 feet; and *F*, in excess of 3000 feet.

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[10] Smith, *op. cit.*

[11] E. H. Hammond: 'An Objective Approach to the Description of Terrain', a paper presented to the Association of American Geographers at Philadelphia, Pennsylvania, U.S.A., in April 1954. This paper contains a valuable discussion of this problem and that of selecting criteria suitable for an objective description of the characteristics of landforms. (An abstract was published in *Annals Assoc. Amer. Geogrs.*, Vol. 44, No. 2, 1954, p. 210.)

Slope is a landform characteristic which has peculiar significance to a considerable group of human activities and is also closely related to many physical phenomena. Unfortunately slope is difficult to measure and express areally. In addition, accurate information about slope is lacking for large parts of New Zealand, and consequently, the classification treats it only in a general way. Considered here is the portion of total area occupied by slopes of a distinctive and culturally-important class: the percentage of gently-sloping land, with slopes of less than eight percent, in each unit area. Two subdivisions are made: (*1*) less than half; (*2*) more than half; of the land gently sloping.

To one's perceptions, and to cultural geography, *profile* is a very significant terrain characteristic. In New Zealand tabular and terraced landforms occupy relatively large areas and these are distinguished from those with other profiles by assessing the position of most of the gently-sloping land in each unit area. On this basis three subgroupings are made: *a*, more than two-thirds of the gently-sloping land is in the lower half of the elevation range; *b*, more than two-thirds of the gently-sloping land is in the upper half of the elevation range; *c*, gently-sloping land is scattered through the elevation range.

New Zealand Landforms

Although only three differentiating criteria are used in the scheme presented here, the possible combinations of characteristics provide no less than thirty-six classes. The cartographic representation of such a multiplicity of groups would be very complex. Fortunately, New Zealand landforms can be described effectively in terms of ten basic terrain types. The thirty-six classes have therefore been combined, as indicated below, into the ten major groups whose distribution is shown by the maps in Figures 1, 2 and 3. This classification is based on local relief and all classes are determined by this criterion; subdivisions are made on the basis of slope and profile. This method is employed because of the universal availability of data on local relief and because of its diagnostic descriptive properties.

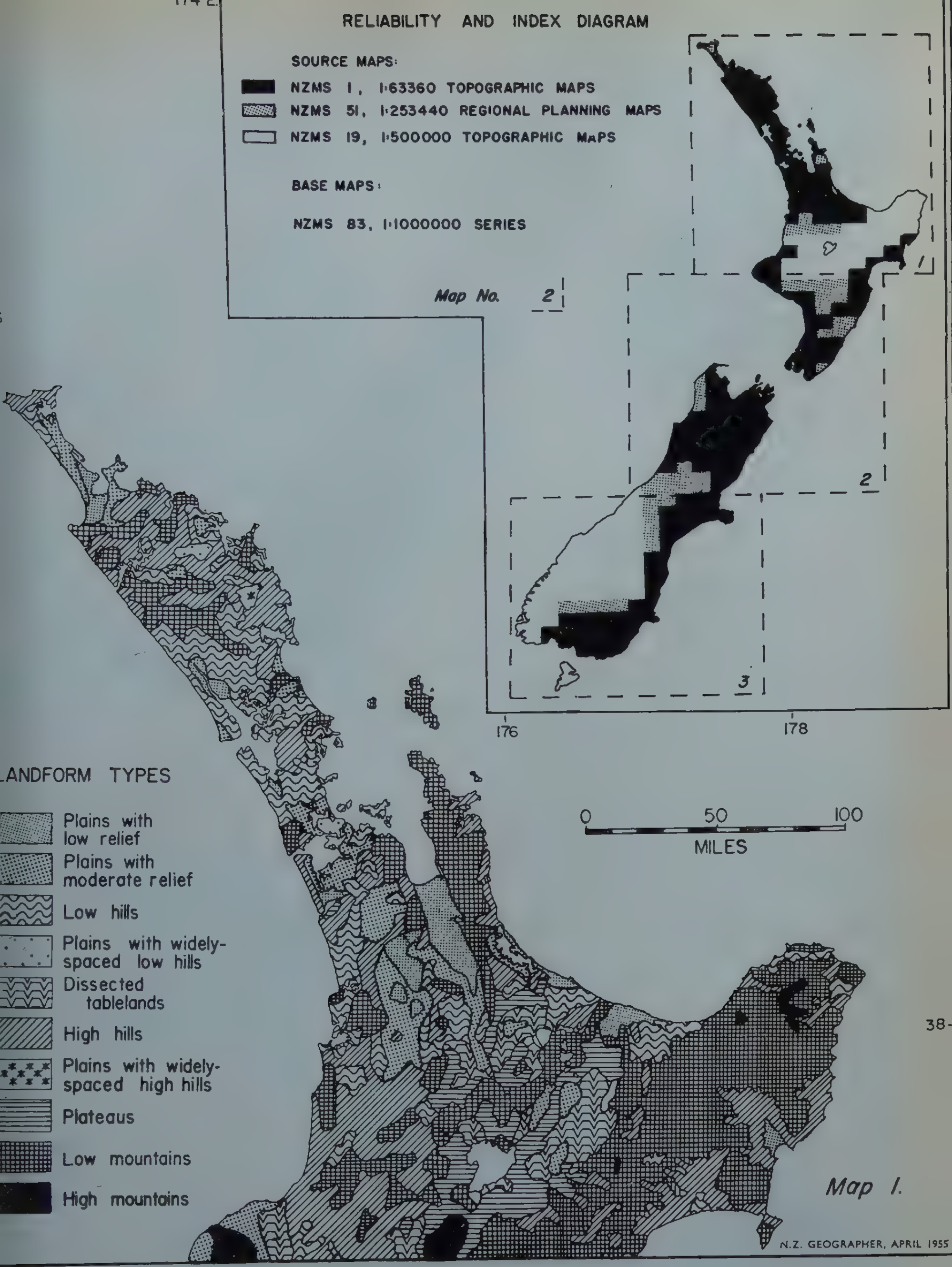

RELIABILITY AND INDEX DIAGRAM
SOURCE MAPS:
NZMS 1, 1:63360 TOPOGRAPHIC MAPS
NZMS 51, 1:253440 REGIONAL PLANNING MAPS
NZMS 19, 1:500000 TOPOGRAPHIC MAPS
BASE MAPS:
NZMS 83, 1:1000000 SERIES
Map No.
1
2
3
176
178
LANDFORM TYPES
Plains with low relief
Plains with moderate relief
Low hills
Plains with widely-spaced low hills
Dissected tablelands
High hills
Plains with widely-spaced high hills
Plateaus
Low mountains
High mountains
0
50
100
MILES
38
Map 1.
N.Z. GEOGRAPHER, APRIL 1955

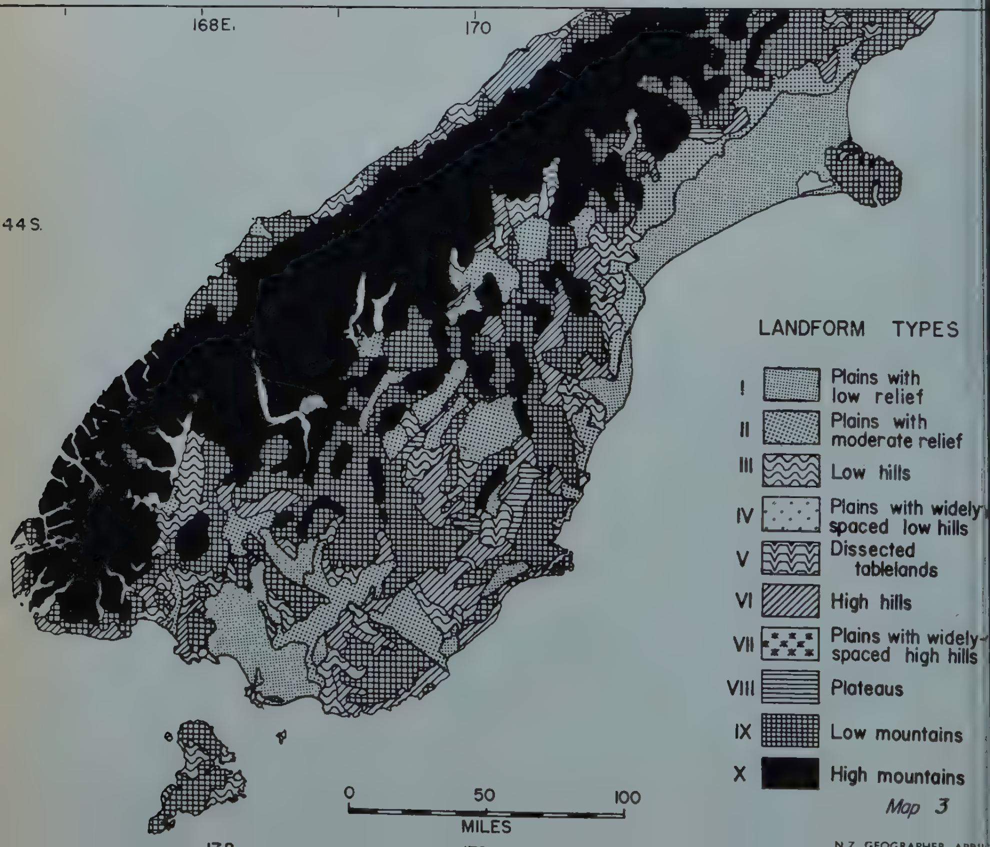
Fig. 1. Landforms of northern New Zealand.

Where terrain has little relief (less than three hundred feet) no subdivision of the basic relief classes is made. This procedure is followed because in New Zealand profile and prevalent slope do not differentiate significantly distinctive types of landforms within this low relief range. The countless minor variations that would be revealed would unnecessarily complicate the landform pattern shown on the maps. Thus twelve classes with relief of less than three hundred feet are combined into two major terrain types.

In areas of greater relief, profile and slope character have greater geographic and descriptive significance, and the intermediate groups in the classification are defined by the use of these characteristics. Hills are differentiated from other terrain types within the relief range of three hundred to one thousand feet by assessing the portion of gently-sloping land. Plains with widely-spaced hills are distinguished from tablelands and plateaus on the basis of profile. In this way twenty-four classes are grouped to make up six basic terrain types.

Profile and slope have even greater descriptive significance where local relief is in excess of one thousand feet. However, the tablelands and plains with widely-spaced mountains which might be distinguished from the areally dominant mountains on this basis are too restricted in occurrence to be significant in an analysis of New Zealand as a whole, and their area is also too small to be shown on maps of the scale used here. Consequently all land with local relief in excess of one thousand

Fig. 2. Landforms of southern New Zealand.



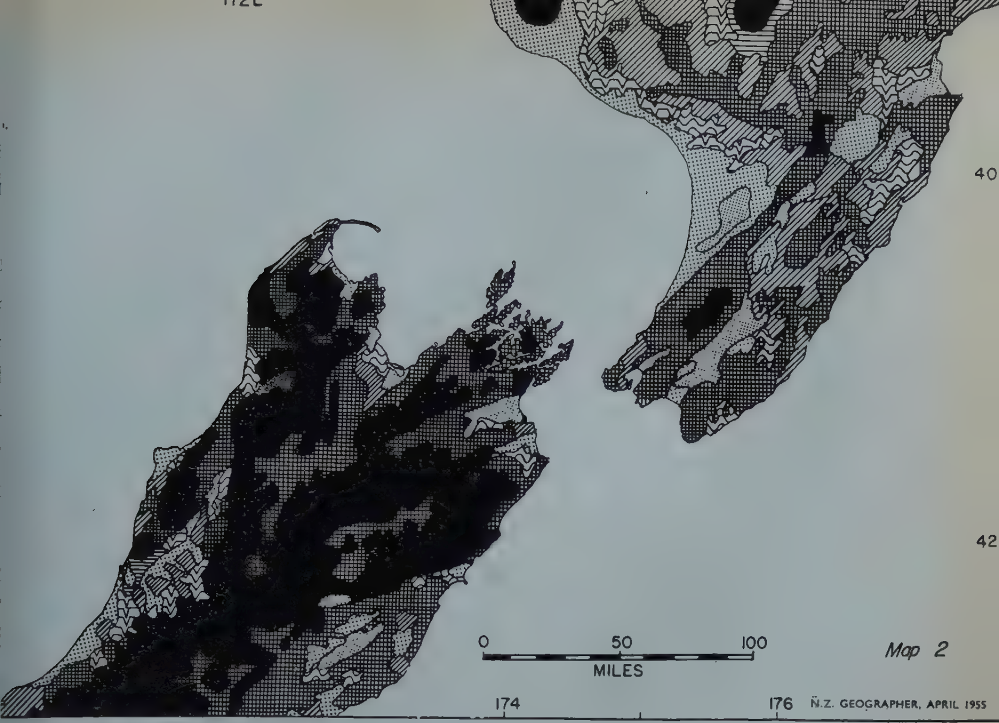


Fig. 3. Landforms of central New Zealand. (See Figure 2 for key.)

feet is classed as mountainous and the twelve possible classes become two terrain types—low and high mountains.

The ten major types of terrain distinguished in New Zealand are:

I. *Plains with Low Relief* or *Near-Flat Plains*—Areas with local relief of less than one hundred feet; profile and proportion of gently-sloping land not significant. Classes: *A1a, A1b, A1c, A2a, A2b, A2c.*

II. *Plains with Moderate Relief* or *Irregular Plains*—Areas with local relief between one hundred and three hundred feet; profile and proportion of gently-sloping land not significant. Classes: *B1a, B1b, B1c, B2a, B2b, B2c.*

III. *Low Hills* or *Downland*—Areas with local relief between three hundred and six hundred feet; less than half of the land gently-sloping; profile not critical. Classes: *C1a, C1b, C1c.*

IV. *Plains with Widely-Spaced Low Hills*—Areas with local relief between three hundred and six hundred feet; more than half of the land gently-sloping; most of the gently-sloping land situated in the lower part of the elevation range. Class: *C2a.*

V. *Dissected Tablelands*—Areas with local relief between three hundred and six hundred feet; more than half of the land gently-sloping; most of the gently-sloping land situated in intermediate or upper parts of the elevation range. Classes: *C2b, C2c.*

VI. *High Hills*—Areas with local relief between six hundred and one thousand feet, less than half of the land gently-sloping; profile not critical. Classes: *D1a, D1b, D1c.*

VII. *Plains with Widely-Spaced High Hills*—Areas with local relief between six hundred and one thousand feet; more than half of the land gently-sloping; most of the gently-sloping land situated in the lower part of the elevation range. Class: *D2a.*

VIII. *Plateaus*—Areas with local relief between six hundred and one thousand feet; more than half of land gently-sloping; most of the gently-sloping land situated in upper or intermediate parts of the elevation range. Classes: *D2b, D2c.*

IX. *Low Mountains*—Areas with local relief between one thousand and three thousand feet; profile and proportion of gently-sloping land not critical. Classes: *E1a, E1b, E1c, E2a, E2b, E2c.*

X. *High Mountains*—Areas with local relief greater than three thousand feet, profile and proportion of gently-sloping land not critical. Classes: *F1a, F1b, F1c, F2a, F2b, F2c.*

The names applied to these terrain types may be unfamiliar or may seem unsuitable to some readers. This is not important, for so long as the characteristics which identify the landforms are understood their nomenclature is not of prime significance. It is also quite possible that workers concerned with smaller areas will find it purposeful to subdivide these ten groupings in order to describe more effectively the surface configuration of a particular district.

RELIABILITY OF DATA

This classification has been applied uniformly to all parts of New Zealand with as much precision as available information permits. Accuracy varies with that of the maps, air photographs, field observations and other data employed in the investigations. Thus the most reliable portions of the landform maps are those of the areas which are covered by the topographic sheets in the series: N.Z.M.S. 1 (1 : 63,360), N.Z.M.S. 2 (1 : 25,000), and N.Z.M.S. 86 (1 : 15,840).[12] Elsewhere the maps in the series N.Z.M.S. 19 (1 : 500,000) and N.Z.M.S. 10 (1 : 253,440) are the basic sources of information. Consequently the accuracy of the maps in Figures 1, 2 and 3 is less for the central upland of the North Island and for the interior and southwestern portions of the South Island than for other sections of the country.

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[12] See the reliability diagrams which accompany the maps.

It would be interesting to compare these maps with those based on a genetic classification of landforms. Unfortunately, this cannot be done. No comprehensive and detailed maps of New Zealand comparable with those of Fenneman[13] or Linton[14] have yet appeared.

Although the maps (*Figs.* 1, 2 and 3) are only a beginning, they offer geographers new possibilities in the accurate, objective description of the terrain of New Zealand. A fundamental contrast in terrain between the two islands is evident. The South Island is essentially mountainous; it has no counterpart to the large hill-country areas of the North Island. The surface configuration of the North Island is extremely varied, but there high mountains of the sort which dominate the interior of the South Island are very rare. Tablelands, which make up much of the centre of the North Island, are uncommon on the South Island. Plains occupy but small portions of either island. Peculiar to the South Island, however, are extensive interior basin plains. Virtually all North Island plains open on to the sea.

The maps also reveal similarities of surface configuration in various parts of New Zealand. Hill lands with mountainous cores characterise Northland, interior Taranaki and most of Eastland. Tablelands which are alike in both form and location are found in Taranaki, Wanganui, Eastland, Westland and Otago. The essential similarity of form of the mountains in East Otago, on Banks Peninsula and in most North Island 'ranges' is also evident. Large near-flat plains are rare. Indeed, there are only three in the whole of New Zealand: Hauraki, Canterbury and Southland.

FUTURE DEVELOPMENT

Much more important than the utility of these maps, however, is the interest in the objective approach to the description of landforms which this paper may stimulate. The maps presented here are but a preliminary investigation. It is earnestly hoped that others with more advanced concepts and better data will work on a larger scale and reveal the inadequacies of this early effort. Such work and interest will both illustrate and test the geographical significance and methodological soundness of this type of landform description.

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[13] N. M. Fenneman: 'Physiographic Divisions of the United States', *Annals Assoc. Amer. Geogrs.*, Vol. 18, 1928, pp. 261-353; *idem: Physiography of the Western United States*, New York, 1931; and *idem: Physiography of the Eastern United States*, New York, 1938.

[14] D. L. Linton: 'The Delimitation of Morphological Regions', in L. D. Stamp and S. W. Wooldridge (Eds.): *London Essays in Geography*, London, 1951, pp. 199-218; and the map in J. Bartholomew: *Advanced Atlas of Modern Geography*, London, 1950, pp. 32.

THE PHYSICAL GEOGRAPHY OF WESTERN SAMOA[*]

LESLIE CURRY

THE United Nations Trust Territory of Western Samoa presents a series of problems of absorbing interest for geographical analysis. Although most of these are social and economic, they cannot be understood, much less solved, without a knowledge of the physical character of the territory. Unfortunately, little detailed work has been done by the systematic scientists and there are large gaps in the basic data necessary for anything approaching a complete survey of the physical geography of the area.

Western Samoa consists of two main islands, Upolu and Savai'i, together with several small islands, the most important of which are Manono and Apolima lying in the straits separating the two main islands. Forty miles to the east is American Samoa, a group of small islands.

Samoa lies off the main southwest Pacific trade routes, although aircraft on the 'Coral Route' from Australia and New Zealand via Fiji, Samoa, and the Cook Islands to Tahiti call fortnightly at Satapuala. The only regular sea transport is a bimonthly service to New Zealand via Fiji and Tonga. Western Samoa, then, is a relatively isolated island group, the largest island of which, Savai'i, is some 730 square miles in extent, while Upolu has an area of 430 square miles.

Settlement is almost entirely coastal, with cultivation extending no more than three or four miles inland. The interiors of the islands act as barriers to cross-island traffic. Coastal land traffic also meets barriers.

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[*] The author spent two months in the islands in the summer of 1953-1954 making a reconnaissance survey. The time spent was quite inadequate for the task, but this resulting report sums up present knowledge and provides a basis for future work. Since this study of the natural resources of Western Samoa is the forerunner of a larger group study of the social and economic geography of that territory, the physical facts have been evaluated where possible from the point of view of present or potential human use.

Thanks are due for financial assistance to the University of New Zealand Carnegie Social Science Research Committee, and for willing cooperation and kind assistance to Mr. G. R. Powles, New Zealand High Commissioner for Western Samoa, and his officers. Valuable help was also received from Mr. J. B. Wright, Secretary, Department of Island Territories; Mr. D. R. Eden, General Manager of New Zealand Reparations Estates; and the staff of the Apia Observatory. To numerous hosts and informants, Samoan and *palagi*, deep gratitude is expressed.

In Savai'i, the recent lava flows are uninhabited, without water and difficult underfoot; consequently, settlement is confined to a number of pockets with poor access.

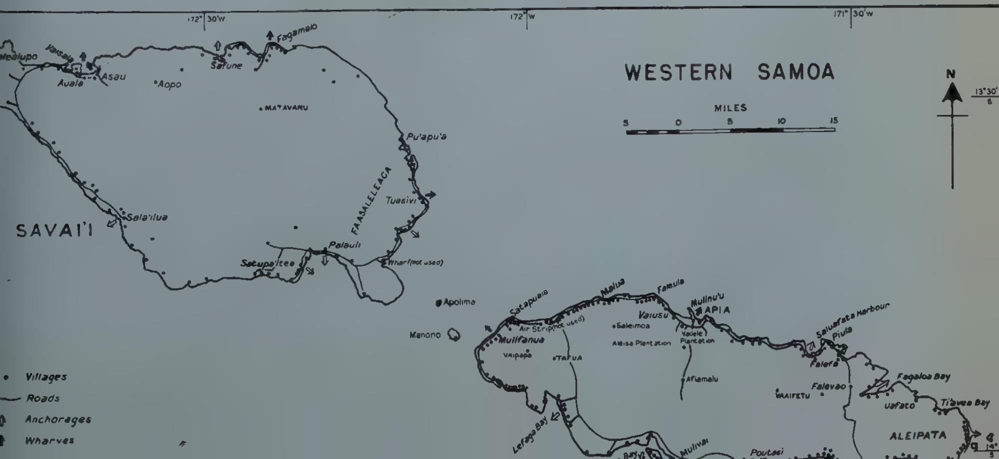
In Upolu, movement along the coast is broken by steep hill country abutting the sea, particularly in the Tafua and the Fagaloa areas. On this island, cross-island roads have been built, the first taking the easy saddle between the Tafua hills and the main ridge, and the second, almost completed, crossing south of Falevao. This latter road is no easier than other possible routes on either Savai'i or Upolu, so that it can be seen that it is not surface configuration but, rather, lack of need which precludes roads.

Focus of Western Samoa

Apia has developed as the port of Western Samoa for overseas shipping. A wide gap in the reef provides an open roadstead with some degree of shelter in which goods may be lightered to and from anchored vessels. It may not be the best harbour available but it is firmly established as the prime focus for Western Samoan internal transport. Apart from the circulation within each village, access must be measured in relation to Apia. Here is the major resource factor which differentiates the two islands of Western Samoa: the fact that land transport to Apia is possible or will soon be possible in virtually all parts of Upolu, whereas transport by water as well as by land is necessary on Savai'i. At present the east coast and most of the south coast of Upolu rely on water transport to Apia, but roads are under construction and will soon cover most of this territory.

In areas not linked to Apia by road, access is measured in relation to coastal shipping points. Such ports of call for the coastal motor vessels are often merely anchorages, although a jetty may be available,

Fig. 1. Western Samoa: settlement and communications.



while, on the other hand, there may not even be a passageway through the reef. The recorded heights of tides do not differ much around the coasts of Western Samoa; the mean high-water spring tides, for example, show a maximum above low water of four and a half feet at Saluafata, while a variation of four feet is found at Fagaloa.[1] The lunitidal interval appears to be longer on the south coast as compared with the north—seven and a half hours compared with six and a half—but this affects only the time at which boats may cross shallow water. Consequently, it is the nature of the coast which determines ease of coastal connections.

The extent of the reef can be seen in Figure 7. It lies off coasts which are not formed of recent lavas, the width of the reef in general increasing with the age of the land behind it. Old rocks have a reef skirting them except where they slope steeply down to the sea, as in northeast Upolu and on the west coast of Lefaga Bay in western Upolu.

Apart from the points where there are breaks in the reef, so making shelter possible inside from heavy ocean swell and storms, there are few sheltered harbours. Fagaloa and Falefa Bays are the most noteworthy of these. Calling points are shown on Figure 1. Trading vessels from Savai'i go direct from Apia, but passengers for the eastern districts of that island may take advantage of the shorter sea route by leaving from Mulifanua. Most villages of Savai'i and of northern and western Upolu are linked by road to a sheltered port or to Apia directly. Vessels serving the eastern and southeastern villages of Upolu not yet joined by roads are forced to cruise along the coast, receiving and delivering cargo and passengers at each village. In recent years a strong incentive to road building has been provided by the risks attendant upon shipping bananas in bad weather. Under such circumstances it is impossible to load the boats and a valuable export crop must be left to rot.

Landform Regions

Physical features, then, are particularly significant in the geography of Western Samoa. In the case of landforms none is more prominent than the central ridge, some 3000 feet high in Upolu and 5500 feet in Savai'i, which forms the backbone to both islands, with the bulk of the land sloping gently to the shore. However, there are important differences in general slope, local relief, surface texture and other features in different areas. In describing these features it is useful to draw rather arbitrary regional boundaries, which are shown in Figure 2. Figure 3, showing generalised slopes, and Figure 6, giving elevations, have been employed, along with first and second hand observations in the field, in the compilation of this map. The central backbone is used as a boundary in this map and not defined as a distinct region, except in central Savai'i. The landforms will be discussed below in the section on soils.

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[1] British Admiralty Chart, 1931.

Slopes in Western Upolu (Region 1) rarely exceed nine degrees, apart from those in the Tafua highlands (1a) where they commonly range between nine and twenty-seven degrees. This latter area is very broken country of strong local relief separated from the main island ridge by a low, gently-sloping saddle. Surfaces are mainly smooth in general, but less so in detail. Apart from three streams flowing south from the hill area, virtually no surface water is present. In Region 2 the land slopes northwards from the central ridge. Surface water is more plentiful here and watercourses are numerous. The surface is much more irregular in general, but in detail is fairly smooth. Slopes are still usually less than nine degrees, apart from cones on the ridge and three outlying hills nearer to the coast. The wide, flat-bottomed gullies flanked by steep walls and separated by narrow, often razor-backed, ridges are a characteristic feature of this area.

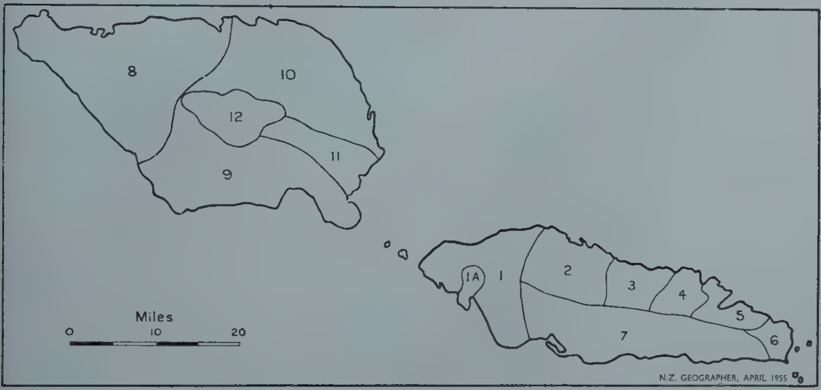
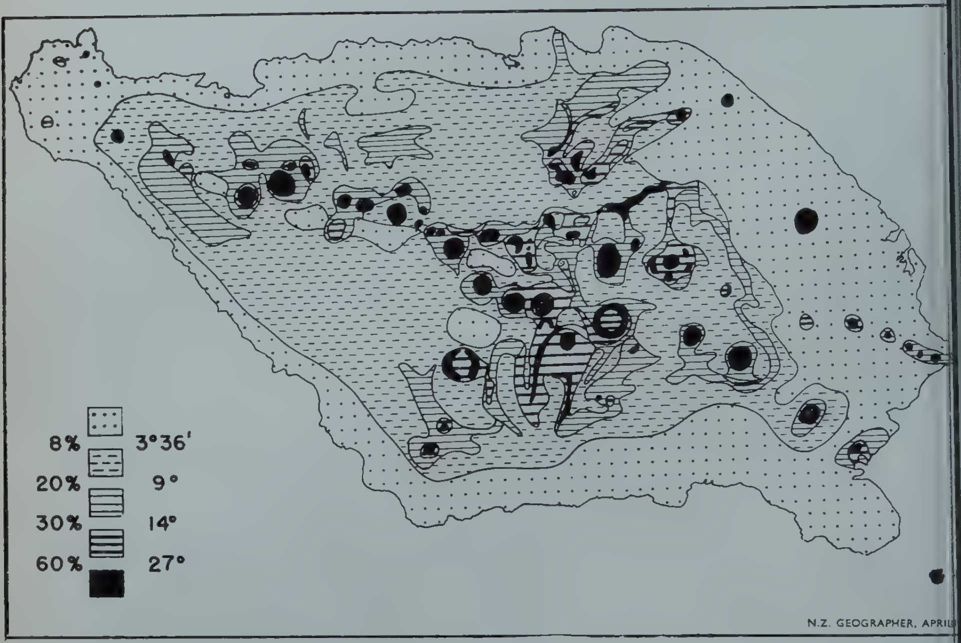


Fig. 2. Landform regions of Western Samoa.

Region 3 consists of the northern slopes from the central ridge with the Vaaifetu ridge to the east and, to the west, the Vailele hill. The slope is between four and nine degrees. The surface is rough and deeply gouged, although smooth in general. Water supply is poor. Region 4 comprises a relatively flat plain of smooth surface bounded to the south by the steeply-rising central backbone and two north-trending ridges. The western boundary is the Vaaifetu ridge and the eastern is the Fagaloa mountain complex. The plain is drained by the Falefa Stream, except in the northeast, where small streams flowing eastwards end in a marshy area.

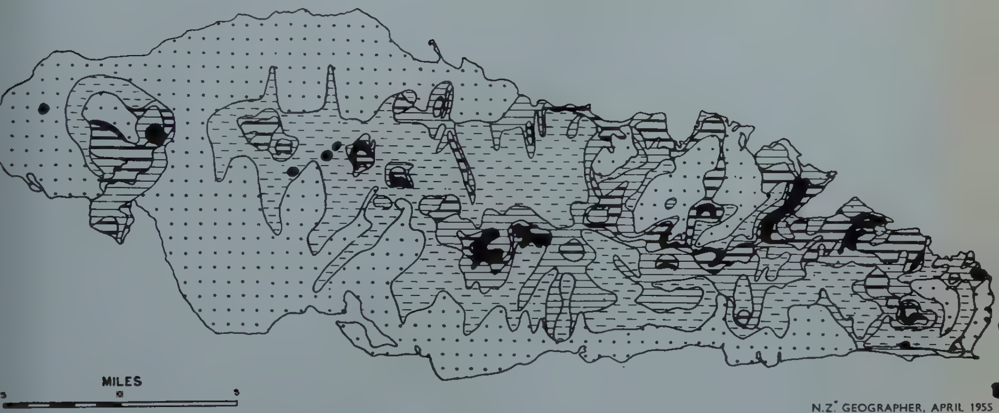


Figs. 3 and 3a. A slope map of Western Samoa (based on German naval maps first published in 1912).

The northeast corner of Upolu (Region 5) contains little level land, most of the area having slopes of over ten degrees and much of it more than fifteen degrees. The land rises sharply from the coast between the eastern side of Falefa Harbour and the western end of Tiavea Bay, including the Fagaloa and Uafato Bays. A series of ridges leads to the main ridge paralleling the shore. The country is much broken with intense local relief and numerous streams cascade down the hillsides into the sea. The western region of Upolu (Region 6) is bounded to the east by the bifurcating main ridge which reaches both the north and south coasts. This country is similar to that to the west of Apia, with gentle slopes below nine degrees, no permanent surface drainage, smooth in general, and rather rough in detail.

The whole south coast of Upolu may be conveniently treated as a single unit (Region 7). The land rises gently from the sea to the central ridge with the greater part of the land having a slope of less than nine degrees. The area is poorly watered on the lower slopes, only three streams giving an appreciable permanent supply. At higher levels it is likely that there are streams which disappear underground. A considerable number of wide, deep gorges, similar to those about Apia and containing streams during the wet season, cut into the hills, but level out before the coast is reached.

Savai'i is divided into five regions. In the west (Region 8) the land rises gently and evenly from the coast, the steepest slope being rarely more than nine degrees until the ridge is reached. The texture of the surface, however, is very rough, and its composition extremely rocky. Water courses are absent. In the southeast (Region 9) slopes are again mainly less than nine degrees, but the land is much more broken. Some of the valleys, like those of Upolu, are prominent and steep-sided, broad and flat-bottomed, with amphitheatres at their heads. The surface is smoother in most of the area and water is more plentiful.



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The slopes of northwest Savai'i (Region 10) are gentle, save for those of the hill area surrounding the upper Matavanu lava flow, which are predominantly between nine and twenty-seven degrees. The surface is smooth in general, but in detail ranges from very rough on the recent and very recent lava to moderately rough in the other areas. Stream courses are rare and permanent surface flows exist only in the

Fagamalo district. The small western region (11) should not, perhaps, be distinguished from its northern neighbour. However, protected as it is from recent lava flows by a line of volcanic cones to both north and south, it is likely to be older and thus its surface to be smoother in detail. The high central region of Savai'i (12) consists of numerous closely-spaced volcanic cones, causing steep slopes to predominate. However, as these cones lie in two definite lines, a restricted area of flat land exists between them. This area is reported to be swampy. Numerous permanent streams exist in the region, disappearing and reappearing at intervals in their courses. It is probable that the area is smooth underfoot.

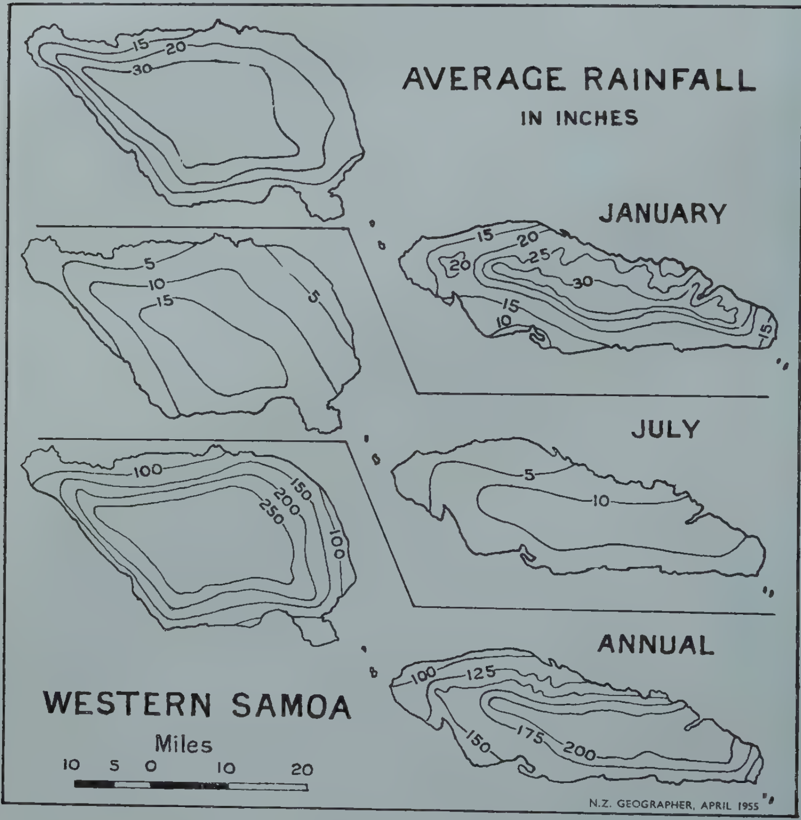


Fig. 4. Rainfall in Western Samoa.

The effect of landforms *per se* on land utilisation has not been marked. Cultivation of some of the steepest slopes has been undertaken and in only rare instances was accelerated erosion seen. However, soil creep may be occurring on cultivated hillsides without being obvious. The

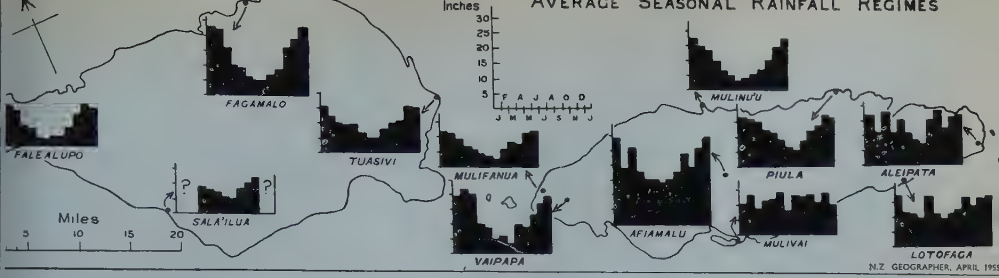


Fig. 5. Rainfall regimes at selected stations in Western Samoa.

slope classes used in the map (*Fig.* 3) are a general index of erosion hazard from cultivation. This index might be taken into account in planning land development.

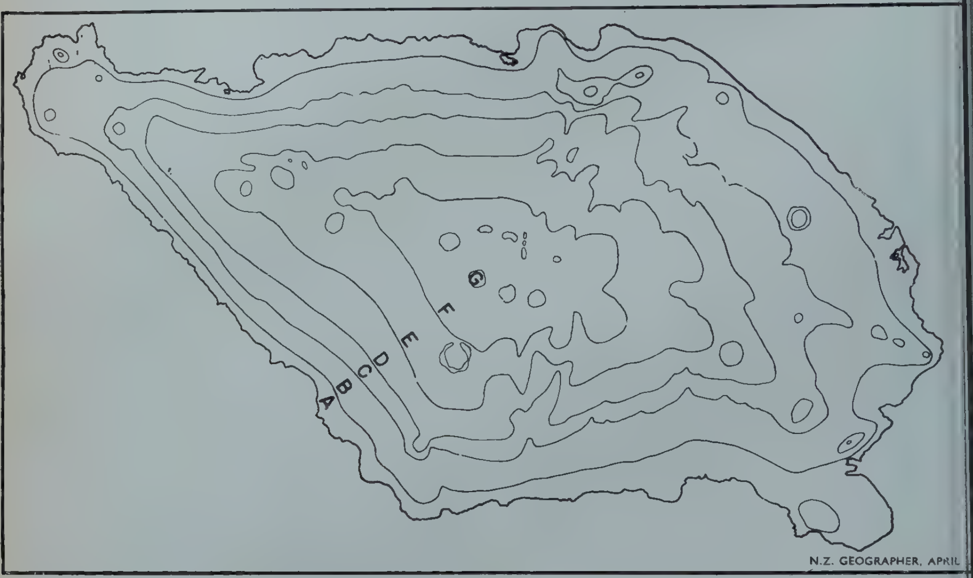
Nor is the form of the land an undue hindrance to movement except in a few areas. The central ridge is a barrier but not a very difficult barrier to north-south traverse. East-west movement is relatively easy near the coast save for the Fagaloa Bay and the Tafua areas. Again, east-west movement is relatively simple on top of the central ridge which is quite broad and flat. However, this direction of movement can become extremely difficult if routes other than these are chosen. The gullies and ridges leading down from the central backbone of both Upolu and Savai'i virtually preclude cheaply constructed east-west roads in many inland sectors below the main ridge. But such roads are not likely to be needed for many years to come.

CLIMATE

The seasonal rainfall regime characteristic of various stations may be seen in Figure 5. Taking Mulinu'u as the 'normal' regime, there are two distinct rainfall seasons, a wet summer and a drier winter. From the peak months of December, January and February, monthly totals decline to a minimum in June, July and August before rising again. This regime is shared by stations in the north and east section of Upolu and is probably general in Savai'i. A slight modification is found in that, while the Apia district shows its peak month in January, the Piula area has it in December, whilst at Vaipapa it occurs in February. On the west, east and possibly the south coast of Savai'i, a slight dip occurs in the rainy season totals during January. The rise evident in September over these areas is delayed until October on the west coast of Savai'i.

The rainier parts of Upolu—the south, central and eastern parts of the island—diverge markedly from the 'normal' regime. The central ridge shows secondary peaks in March and October. These secondary peaks in spring and autumn are shared by the south and west coasts, so that a relatively even distribution of rain at all seasons occurs, particularly on the south coast.

Since there is only one station in Western Samoa which records temperatures, it is necessary to have some means of extrapolating these



Figs. 6 and 6a. Isolines in Western Samoa: A, sea level; B, 164 feet; C, 656 feet; D, 1312 feet; E, 2624 feet; F, 4100 feet; G, 5576 feet. (See Table I below.)

TABLE I

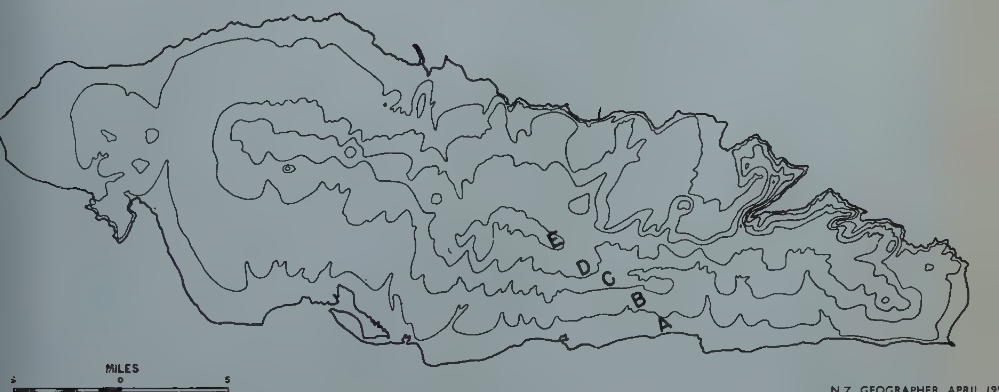
AVERAGE MONTHLY TEMPERATURES IN DEGREES FAHRENHEIT AND AVERAGE MONTHLY POTENTIAL EVAPOTRANSPIRATION IN INCHES

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A*	0m. T°F. 0ft. PE″	79.5 6.0	79.5 5.3	79.5 5.7	79.4 5.3	79.0 5.0	78.4 4.7	77.8 4.7	78.2 4.9	78.6 5.1	79.0 5.6	79.1 5.6	79.5 6.0
B	50m. T°F. 164ft. PE″	78.9 5.6	78.9 4.9	78.9 5.2	78.8 4.9	78.4 4.7	77.6 4.3	77.2 4.3	77.6 4.6	78.0 4.7	78.4 5.1	78.5 5.2	78.9 5.6
C	200m. T°F. 656ft. PE″	77.2 5.1	77.2 4.5	77.2 4.8	77.1 4.5	76.7 4.4	76.1 4.0	75.5 3.9	75.9 4.2	76.3 4.3	76.7 4.8	76.8 4.8	77.2 5.2
D	400m. T°F. 1312ft. PE″	74.8 4.4	74.8 3.9	74.8 4.2	74.7 3.9	74.3 3.8	73.7 3.6	73.1 3.5	73.5 3.7	73.9 3.8	74.3 4.2	74.4 4.2	74.8 4.5
E	800m. T°F. 2624ft. PE″	70.1 3.6	70.1 3.1	70.1 3.4	70.0 3.1	69.6 3.0	69.0 2.8	68.4 2.8	68.8 3.0	69.2 3.0	69.6 3.3	69.7 3.3	70.1 3.6
F	1250m. T°F. 4100ft. PE″	64.9 3.0	64.9 2.6	64.9 2.8	64.8 2.6	64.4 2.6	63.8 2.4	63.2 2.4	63.6 2.5	64.0 2.6	64.4 2.9	64.5 2.9	64.9 3.0
G	1700m. T°F. 5576ft. PE″	59.6 2.7	59.6 2.4	59.6 2.5	59.5 2.4	59.1 2.2	58.5 2.1	57.9 2.2	58.3 2.2	58.7 2.3	59.1 2.5	59.2 2.5	59.6 2.7

*A, B, C, D, E, F, G refer to the isolines in Figures 6 and 6a.

Sea-level readings are 24-hour means for 62 years at Apia. A temperature gradient of 1.17°F/100 metres is us values for other parts of the territory. This adjustment will be a combination of the normal lapse rate with elevation and the degree of continentality, it being virtually impossible to take into account differences in the energy balance according to aspect to the sun.

Angenheister gives two values for normal temperature gradient (which will include continentality): (i) sea level to 600 metres of altitude—0.65°C/100m.;[2] (ii) sea level to 140 metres—0.55°C/100m.[3] Buxton[4] gives a single monthly reading for an open clearing at 1800 feet (550m.) from which a temperature gradient of 0.66°C/100m. can be calculated. It seems likely that the lower-level gradient calculated by Angenheister incorporates a maritime influence which is not applicable to the higher, inland parts of the island. Since it is only valid for the low slopes near the coast, little error is involved in ignoring this. Thus 0.65°C/100m. will be taken as the temperature gradient.[5] This corresponds to 0.36°F/100ft. Figure 6 and Table I have been drawn on this basis.



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Calculating the water balance of the soil involves compounding estimate on estimate. However, it does give some idea of where and when there is a lack of moisture available for plant growth. Thornthwaite's method has been followed using average values and assuming a soil storage capacity of four inches. The only stations which show an absolute deficit are Malua (0.4 inch in August and 1.2 inches in September), Fale'ula (2.0 inches in August, 2.2 inches in September and 0.8 inch in October) and Falealupo (0.6 inch in July, 1.7 inches in August and 2.0 inches in September). Thus, *on the average,* one small district in northwest Upolu and one in Western Savai'i show a deficit. If districts are considered in which soil moisture storage is being worked without actually being exhausted, the areas are wider. In Upolu the whole northwest section of the island is affected up to about 750 feet. In Savai'i, it is also the northwest section.

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[2] G. Angenheister: *A Summary of the Meteorological Observations of the Samoan Observatory, 1890–1920,* Wellington, 1924, pp. 40 and 52.

[3] *ibid.*, p. 40.

[4] P. A. Buxton and G. H. E. Hopkins: *Researches in Polynesia and Melanesia,* Parts I-IV, London, 1927, p. 20.

[5] *cf.* values for Peru (16°S.)—0.61°C./100m.; and Ceylon (7°N.)—0.64°C./100m. quoted by V. Conrad: *Methods in Climatology,* Cambridge, Mass., 1944, p. 182.

PROBABILITY OF DROUGHT

However, the amount of rain falling in any month varies considerably from year to year, and consequently average values are a poor indication of conditions actually experienced. Apia, for instance, shows no deficit on the average, but this takes no account of variability of monthly rain totals from year to year. Table II shows the amount of rain which falls in given percentages of the total months recorded. It can be seen in the case of Apia that, while soil storage would be full in almost all cases in April, this would be drawn on, if available, in forty-nine percent of the months of May, fifty percent of those of June, seventy percent of those of July and August, fifty percent of those of September, and thirty-five percent of those of October. Drought probabilities are therefore strong. Study of the figures for Mulifanua shows an even stronger probability, implying that there will be few years that do not experience a water deficit. On the other hand, the statistics for Lotofaga, representing Southern Upolu, show that there is little chance of drought occurring.

Generally, then, it may be claimed that the northwest sections of both islands, up to an altitude of approximately 750 feet, will all experience drought in a considerable proportion of years. As elevation increases, the possibility of drought declines rapidly because of increasing rain and decreasing temperature. Drought probability will also decline towards the south and east coasts. It is a strange fact that the area of Upolu showing maximum drought probability contains the greatest concentration of population and also the majority of the European estates.

A comparison of the maps of rainfall and evapotranspiration shows that an enormous quantity of rain must find its way to the sea.

TABLE II

RAINFALL PROBABILITIES AT THREE STATIONS IN WESTERN SAMOA*

Station	Percentage of Months	Jan.	Feb.	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
Apia	20	10.5	9.0	8.5	5.8	3.0	2.2	1.5	1.4	2.6	4.2	6.4	9.0
	40	14.7	12.7	10.9	7.9	4.8	3.6	2.4	2.6	4.0	6.1	8.5	12.7
	60	18.3	15.9	13.3	10.2	7.1	5.4	3.8	3.9	5.6	8.0	10.6	15.9
	80	22.3	20.2	17.1	13.8	10.4	8.3	5.6	5.8	8.1	10.5	13.8	20.2
Mulifanua	20	7.0	6.1	7.1	4.6	2.7	1.3	1.5	1.5	2.7	4.4	4.8	7.0
	40	9.8	8.6	8.4	5.8	4.2	2.7	2.4	2.4	4.2	6.4	6.6	9.5
	60	13.3	11.4	9.0	7.0	5.9	4.3	3.5	3.2	6.0	8.6	8.6	12.6
	80	18.9	15.0	11.6	8.4	8.2	5.9	5.0	4.6	9.1	11.4	12.2	18.0
Lotofaga	20	9.2	7.5	7.5	6.4	10.5	6.4	6.0	6.4	6.0	9.3	9.0	11.8
	40	13.0	10.0	9.7	8.4	14.7	8.4	8.2	8.4	10.0	12.5	12.4	14.6
	60	16.4	12.7	12.2	10.2	19.5	11.7	10.3	11.7	13.7	17.0	15.0	17.9
	80	21.3	16.0	16.0	12.6	27.0	17.3	13.1	17.3	18.5	21.4	18.8	22.6
Average Potential Evapotranspiration in Inches at Sea Level		6.0	5.3	5.7	5.3	5.0	4.7	4.7	4.9	5.1	5.6	5.6	6.0

This table was obtained in the following manner. The lowest recorded rainfall for a month equals 1, the next lowest equals 2, and so on; these rank values are termed *n*. The total number of months of the record equals *N*. Using the formula $\frac{2n-1}{2N}$ gives a value which can be used in plotting the percentage number of occurrences of rain equal to or below that of a certain value. The points were graphed on probability paper with a logarithmic y-axis and a smoothed curve drawn for each station month. From these curves the values shown in the table were obtained.

* Rainfall shown in each month is equal to or below the stated value in inches for the given percentage of those months.

CLIMATE AND CROPS

The period of planting is affected by the moisture balance of the soil. In general the aim is to plant crops just before or early in the wet season so that young seedlings will develop without much fear of drought. In areas where moisture is usually adequate at all times of the year, there is no periodicity in planting. Thus, in the case of taro and ta'amu, planting takes place all the year round on the south coast of Upolu. On the northwestern section of this island planting occurs in January, early in the rainy period. The Fa'asalele'aga district of eastern Savai'i exhibits a similar periodicity, but in the west and south of that island, planting occurs mainly in August and September, just as rainfall is increasing. The commercial crops—cocoa, coconuts and bananas—are planted at about the same time as taro and ta'amu, with perhaps a tendency to delay cocoa planting further into the wet season. On the other hand, yams appear to be planted at the times of lowest rainfall. On the west and south coasts of Savai'i and in northwest Upolu June to August is preferred as the season of planting.

The times of crop harvests appear to be closely defined by differing regional climates. Thus, while six to seven months must elapse before taro can be lifted in the wetter areas, in the drier areas eight to nine months are required. Similarly, ta'amu demands between eight to nine months and a year. While growers in the wetter areas get a quicker crop, they do not appear to be able to leave the crops in the ground for as long a period of time.[6] Thus, ta'amu can be kept for three years in drier regions and two years in moister areas, comparable periods for taro being about eighteen months as against approximately twelve.

In the case of breadfruit there appears to be little simultaneity between either harvest times of different regions or of these and any climatic periodicity. This observation demands closer study since, if it be correct, it appears that breadfruit harvests are going on during most of the year in one or other Samoan district. As this fruit provides for little labour a much appreciated food, there may be scope for interregional exchange.

Cocoa development is closely related to climate. On the northwest coast of Upolu, peak production of mature beans follows in November after the dry season, while a secondary peak occurs about six months earlier, in April and May, just before the dry season commences. In the Palauli district, these seasons are advanced about two months, possibly because of the earlier ending of low soil moisture conditions.

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[6] These features may be due either to a sufficiency of soil moisture or to the location of gardens in cooler areas.

As will be mentioned later, dadap (*Erythrina*) is interplanted with cocoa in the plantations of west and northwest Upolu in order to provide soil nitrogen. It also has another function in providing shade for young cocoa until the stage of full bearing at four years. Cocoa up to this stage has a fairly restricted root system and, by reducing leaf temperatures, the transpiration rate, and thus the possibility of drought, is lessened. The dadap is allowed to grow freely during the dry season and its roots, presumably, do not offer competition to those of the cocoa. In the rainy season, the trees are cut back severely since there is plenty of soil moisture available and shade is not required. If this explanation is correct, shade trees are only necessary in areas which experience periods of drought. Certainly on the south coast of Savai'i at Sala'ilua young cocoa flourishes without their aid. On the other hand the interplanting of other crops with cocoa is not necessarily for shade. Bananas and ta'amu are often grown in this fashion, representing simply an economic use of land while the cocoa trees are still small.

Climatic Controls

One of the major difficulties of growing cocoa in Western Samoa is the incidence of black pod. This disease appears to flourish in wet conditions, for in the European plantations of northwest Upolu it is much more serious in the wet season than it is in dry weather. Indeed, it is believed that the present upper boundary of cocoa planting at about 600 feet is the result of the greater incidence of black pod as rain increases with height. It can thus be seen that the drier areas of Western Samoa are most favourably equipped to avoid black pod in cocoa. For instance, the south coast reports severe disease losses, whereas the northwest coast of Savai'i shows only moderate infestation.

Drought conditions must have an adverse effect on crop yields. A little evidence is available to support this view. On European coconut plantations cattle are grazed on pasture beneath the palms. The Mulifanua area, in which are the most important coconut areas, also suffers from severe drought as has been shown (Table II). During the dry season feed is inadequate for the cattle so that, in severe years the thin, half-starved beasts have to be transferred to higher pastures where growth is still vigorous. Lack of moisture has a similar effect on coconut palms too. At Vaisala in northwest Savai'i, for example, nuts are few in number and may drop off the trees while still green.

Unfortunately no yield data have been collected for various crops and districts, although it is clear that they would be of immense benefit in advising on the best crops and practices for particular areas. For instance, it appears that the small amount of coffee which is grown comes mainly from Aopo in northwest Savai'i and from northwest Upolu, both areas of drought. If the cooler higher parts of Western Samoa are to be settled for agriculture, it may be necessary to introduce new crops or adjust practices to the slower rate of development of existing crops.

In the northwestern sections of both islands the crop profile inland from the sea consists of coconut plantations bordering the village on the coast, and with cocoa dominant higher up. Then comes a thick belt of forest before the taro gardens are reached. There are modifications of this pattern as a result of the interplanting of ta'amu with cocoa in recent times. The main point to be noted is that the principal food crops were grown at considerable elevations until recently. On the south coast, however, there is no such forest belt between the commercial crops located as close as possible to the village and the subsistence crops. This difference may well be a function of climatic differences. Drought probability is very much less at higher elevations in the northwestern areas, whereas on the south coast drought does not present such a problem and, consequently, need not be guarded against.

The consistently high temperature and humidity of the air of lowland Samoa have profoundly influenced the type of housing which exists. While roofs are necessary to keep out rain, any walls would exclude cooling breezes. Consequently, houses consist essentially of a thatched roof supported on posts, with surrounding plaited blinds which can be let down to keep out driving rain or cold night air. Again, the building up of the floors from the ground, especially in houses of chiefs and orators, allows a greater velocity of air movement to be experienced than if the floors were level with the ground. The siting of villages on the coast takes advantage of sea breezes which are characteristic of the islands.[7]

VEGETATION

Virtually all Western Samoa is forested, the forest appearing from the sea as a single dark green cover over the islands. However, differences between areas do occur, especially with increasing height or, more correctly, with climate. Closer study may well find other zoning factors present, soil differences among them.

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[7] Angenheister: *op. cit.*

Thompson[8] appears to use the characteristic species to differentiate his forest zones. However it is doubtful whether sufficient information is available for this to be done even approximately. For instance, he writes of mamala (*Homolanthus acuminatus*) as being typical of 'high elevation forest from 1500-4000 feet', but this was recorded by the writer at 650 feet. Similarly, talie (*Terminalia catappa*) was found not only in coastal and lowland forest but also up to 1800 feet. Again, aloalo (*Premna taitensis*) is recorded by Thompson as typical of high elevations, whereas Christophersen[9] found it in the open places of lowlands and foothills.

The forest physiognomy is here adopted as the most convenient means of showing areal differences. Criteria used are: height of crowns; distance apart of trunks of more than two feet in diameter; and the presence and relative abundance of creepers, ferns, mosses, trees thinner than two feet in diameter and undergrowth. Depth of forest litter is also taken into account, but this is, strictly speaking, more a soil characteristic. It must be emphasised that the recording of these phenomena was done in only a small number of traverses, so that findings are tentative.

ALTITUDINAL ZONATION OF FOREST

Forest near the northwest coast of both islands has virtually no epiphytes, little undergrowth and few, if any, ferns and creepers. Litter, too, is thin or absent. Trees are about seventy feet high and those of two feet or more in diameter stand about forty-five feet apart.[10] Thin saplings twenty to forty feet high are close. Many birds can be heard. At about 1500 feet trees are usually eighty feet in height and approximately sixty feet apart. Plenty of small and intermediate trees are present. More creepers, small ground ferns, as well as perched ferns, occur. Litter is generally half an inch in depth.

By the time 1650 feet is reached, trees are eighty-five to ninety feet high and about sixty feet apart. There are many ferns up to three feet in height and many more perched ferns are found. Lots of creepers, including climbing vines, occur and litter is from one half to one inch in depth. At 2000 feet the height of the trees appears to have fallen to about seventy feet, but they are closer together at about forty-five feet. Ground ferns are dense, exist in greater variety, and many reach the height of trees. Perched ferns are plentiful, the bird's nest fern occurring at this height; vines are common but not dense; and trees are mossy, with fungi evident on dead logs.

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[8] T. S. Thompson: 'The Territory of Western Samoa', *Empire Forestry Rev.*, Vol. 82, No. 4, 1953; and C. Marshall and T. S. Thompson: *Forestry in Western Samoa*, Apia, 1950.

[9] E. Christophersen: 'Flowering Plants of Samoa', *Bernice P. Bishop Museum Bulletin No. 128*, 1935.

[10] This closeness may only be evidence of recent secondary growth.

Near the south coast, where rain is relatively plentiful throughout the year, some of the characteristics of the previous intermediate areas are present. A thin ground cover of low ferns occurs and some perched ferns are found. A few creepers are evident. Litter, however, is thin. At 700 feet a rich fern floor, many perched ferns and creepers, and a light moss on trees are characteristic. These features are to be found only at 1800 feet on the northwestern portions of the islands. By 1000 feet moss is thick and hangs heavily on the trees. At 2000 feet two pronounced tree layers are present, as well as a thick ground layer of ferns and shrubs. The middle layer consists of giant tree ferns and the upper layer, which is not continuous, of tree crowns. It is probable that those parts of the north coasts of both islands which possess as low drought probabilities as the south coasts will exhibit a vegetation profile approximating that of the south coasts.

No observations were made of the higher parts of Savai'i. Thompson designates 'Moss Forest' and 'Mountain Scrub' above 4000 feet, but this is probably inferred from a general knowledge of Pacific forest. Merrill,[11] generalising for all the Pacific area, has 'Mossy Forest' which starts at about 2000 feet, passing into 'Elfin Forest' which ends at about 8000 feet. In Western Samoa, the former begins at about 1300 feet on the south coast and at 2500 feet on the dry parts of the north coast. 'Elfin Forest' comes in gradually in the form of dense scrubby undergrowth at about 2100 feet on the south coast, but many trees still occur at this height. The elevations at which true 'Elfin Forest' begins are not known. The very recent lava flows of Aopo and Matavanu in northern Savai'i bear only a sparse low vegetation of six to seven feet, with interspersed bare patches.

MANGROVE FOREST

Another forest type of interest is the mangrove on and near the sea coast. Marshall[12] states that the areas of mangrove, now small, were much more extensive but that cutting of timber has caused erosion, so allowing the sea to swallow up the coastal fringe. But such an occurrence appears most unlikely. In virtually every case where mangrove now occurs special ecological conditions exist. Such areas are Vaiusu Bay, enclosed by the Mulinu'u peninsula and fed by fresh-water streams, and the lagoon areas of the south coast of Upolu, where tidewater springs occur. One curious example of mangrove forest occurs on the edge of a recent lava flow at Pu'apu'a on the Fa'asalele'aga coast of Savai'i.

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[11] E. D. Merrill: *Plant Life of the Pacific World*, New York, 1945.

[12] Marshall: *op. cit.*, pp. 14-15.

The ecological succession following the cutting of 'primitive' bush has not been studied. In general, it appears that fuesina (*Mikania scandens*) is the first occupant following cultivation. This produces a luxuriant mat of vegetation which is prized by Samoans as a builder of humus. Certainly old taro gardens now covered with fuesina showed a considerable humus layer which was often full of earthworms. If fuesina is subject to hard treatment on paths or by grazing, grasses appear dominant. Such a succession has occurred in the cattle areas of the Aleisa plantation of northern Upolu.

SOILS

Five major 'area types' can be recognised from the differences in soil characteristics: (i) the very recent lavas of Savai'i have little or no soil developed on them; (ii) the recent lavas of both islands may appear to have no soil developed on them, but it can be found in the interstices of the rocks and it supports heavy forest; (iii) the young basalts of both islands on which the soils are free-draining yellow-brown clay loams. These soils become lighter in colour with depth[13] and range from excessively stony to little or no stoniness according to the degree of weathering, which in turn depends on age of surface rock[14] and climate. Profile development is noticeable but is not marked, being mainly a small differentiation in colour and degree of compaction; (iv) the high central ridges of Upolu and Savai'i where soils are inclined to be sticky, although still falling in the clay-loam group. Surface soils are darker and horizon development is more marked; (v) the fifth category occurs in restricted areas around the coast, including areas of 'raised beaches', and here the soil has a strong gravelly sand component, especially where little weathering has occurred.

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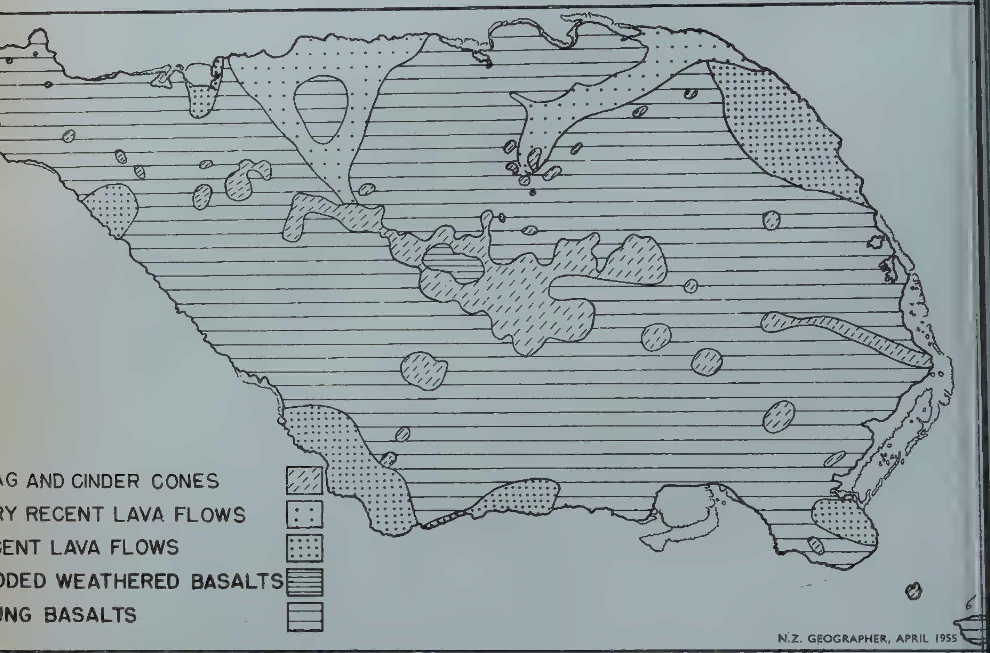
[13] Soil profiles are described in: W. M. Hamilton and L. I. Grange: 'The Soils and Agriculture of Western Samoa', *N.Z. Journ. Sci. & Tech.*, Vol. 19, No. 10, April 1938, pp. 593–624; and F. T. Seelye, L. I. Grange and L. H. Davis: 'The Laterites of Western Samoa', *Soil Science*, Vol. 46, 1938, pp. 23–31. See also: K. S. Birrell, F. T. Seelye and L. I. Grange: 'Chromium in Soils of Western Samoa and Nuie Island', *N.Z. Journ. Sci. & Tech.*, Vol. 21, No. 2, August 1939, pp. 91a–95a.

[14] In general the basalts increase in age from west to east. They constitute the most important areas by far on Western Samoa since they support the bulk of the population. (See Figure 7.)



Figs. 7 and 7a. Sketch map of the surface rocks of Western Samoa.

In order to understand the physical and chemical properties of the soil in greater detail, it is useful to know the soil-forming processes at work.[15] Almost all of the soil types described so far in Western Samoa can be discussed as stages in a common process which varies but little throughout the area.

The parent material of western Samoan soils is basalt of varying age, but mainly of recent origin and of varying particle size, but mainly of coarse material. The temperature ranges from uniformly hot in the coastal areas to uniformly cool in the highest areas of Savai'i. The amount of rain falling is sufficient to cause leaching all the year round, except on the western end of Savai'i and the north and west coasts of Upolu. In these areas leaching is retarded for one to five months. Drainage conditions may be locally important in small lagoon areas, in those craters holding lakes, and in the relatively flat upland areas surrounded by mountains. In general, however, the soils are well aerated.

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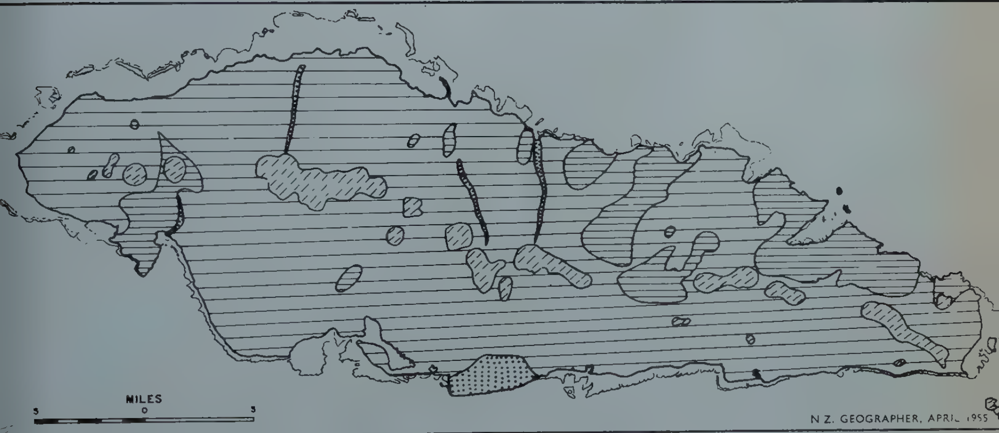
[15] The approach used is that of E. C. Mohr: *The Soils of Equatorial Regions*, Michigan, 1944.

The very recent lavas of Savai'i are virtually in the initial stage of weathering. The basalt gives a soil moisture which is neutral or only weakly acid so that lime, soda, potash, magnesia and silicic acid become available. Consequently, such areas are chemically fertile but are limited by the meagre amount of soil hidden in the rock interstices. Thus they support only small vegetation of about seven feet maximum height which is interrupted by many bare areas.

The recent lavas have advanced a stage further in that sufficient soil exists to support high forest. Some areas, notably western Savai'i, even have sufficient to support agriculture, whereas the remaining areas of this kind are avoided. There is still little soil evident on the surface. These areas are fertile, although they are difficult places in which to start seeds and seedlings because of their excessive stoniness.

Still further in the stage of development are soils such as those of Saleimoa. A large proportion of silica has been lost from the upper layers, together with smaller proportions of lime, soda, potash and magnesia. These soils are very fertile but still very stony.



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It is beyond this point in the process that profiles begin to develop to any extent, and it is this stage that the majority of the cultivated soils of Western Samoa have reached. Alkalis and alkaline earths are being washed out in solution, leaving kaolin holding potassium and calcium, the sesquioxides, titanic acid, some silicic acid, phosphorus and manganese. The abundant plant nutrients, which are only gradually being lost, and the heat and moisture available give rise to a high forest and a large bacteria population. From the organic matter of the forest floor carbonic acid is produced by the bacteria, and this acid, dissolved by percolating water, leaches the minerals of the deeper rock layers. Surface soils are weakly-acid stony clay-loams, dark brown-yellow in colour and gradually losing the dark hues with depth. Such a soil may be termed brown lixivium.

Soils at Higher Elevations

A slightly modified process has gone on in the higher areas. Because of cooler conditions, moulds become more important than bacteria in mineralising the organic matter. But they are much less effective agents, and consequently the organic layers of the soil are deeper. Moss on the forest floor and the cooler soil moisture have caused the environment to be more acid in the upper levels. These soils, as well as having lower pH values, are generally stickier and are further advanced in the weathering process.

As weathering proceeds, various salts go deeper in solution, so that the soil moisture becomes more acid in the upper levels and more alkaline in the lower. On the lower land of Western Samoa this would result in kaolin commencing to move from the upper layers and in silica precipitating in the lower level to form an impermeable layer. The soil immediately above this would be submerged so that access to air is denied. Iron would go into solution, to be precipitated at the top of the water table, and kaolin would remain as a plastic greenish, blue or cream layer. No such soils have been described as yet but they are likely to exist. Similar soils do occur in the higher areas of Savai'i, the difference being that iron and aluminium move from the acid upper layers so that they are never red. Thus, at about 1500 feet in southeast Savai'i, cream or purple heavy clay layers are found in the lower soil horizons.

These more mature soils are probably less fertile than younger ones since they contain less potash and are deficient in available phosphate as a result of their acidity. Nitrogen is probably sufficient so long as there is an uninterrupted return of humus to the soil.

The last class of soil worthy of mention is that found in coastal areas, formed on coral sands. Whereas highland soils are generally acid and lowland soils weakly acid to neutral, the sandy soils are neutral. They appear to be fertile.

The traditional system of Samoan agriculture consisted of cutting the smaller vegetation of an area to form a trash which could then be burnt off. Apart from a few of the very largest, the remaining trees were then cut down and allowed to rot. In the cleared area food crops such as taro and ta'amu were then planted. After one or two crops had been taken off the land was abandoned and the procedure repeated elsewhere. However, each plot appears to have been part of a rather haphazard rotation as the cultivators returned again, perhaps after fifty years or possibly three times in twenty years, when vegetation was reestablished.

This practice appears to accord with the soil processes already outlined. In the first place, burning the organic matter will produce easily assimilable plant nutrients for starting the young food crops off. In the second place, heating the surface soil may release phosphates for use by the plant.[16] Thirdly, the gradually decaying tree trunks will provide a source of organic matter which will be slowly released and which the plants can take up before it is leached out of their reach. Fourthly, the period of rest allows vegetation to become reestablished and so commence the nutrient cycle through soil and vegetation again.

In the centralised plantations around Apia a small amount of potash is applied to blocks of backward cocoa bushes at the rate of three hundredweights per acre per annum in two or three applications during the rainy season. Dadap planted between the rows of cocoa improves soil-nitrogen supplies.

Another feature of Samoan soils is their extremely stony nature. This has meant that the growing of taro and ta'amu is preferred to that of yams since the latter involves the laborious task of removing the stones while the former does not. The scope for mechanisation of cultivation in Samoa is small. Young soils are fertile but too stony. Mature soils are easier to work but should not be clean-cultivated.

SURFACE WATERS

As was shown in the discussion of the water balance, a considerable proportion of the rain falling on Western Samoa is in excess of that used by vegetation and must therefore enter the ground water. But the absence of surface water over a very large part of Western Samoa is an outstanding characteristic of the territory. The reason why surface run-off is so meagre is that recent basalt covers most of the surface area and this is extremely permeable. Allied with the fact that the land has a general slope towards the sea from a central ridge, few discontinuities in lithology or landform exist to force the water to the surface. Thus, springs are found at the edge of the ocean above high water mark or actually under the sea within the reef, the fresh water appearing as a cooler layer on the sea water.

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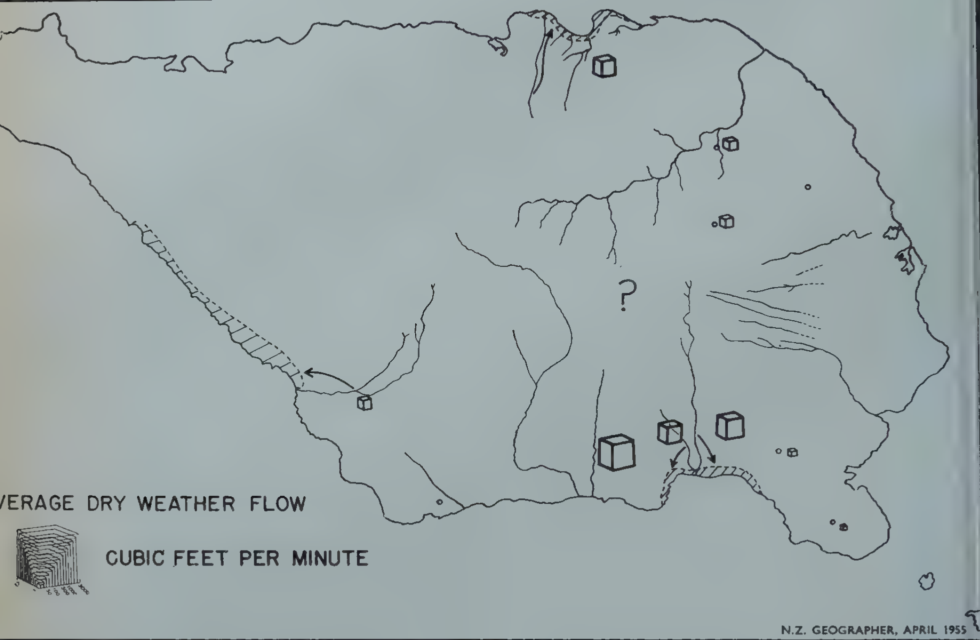
[16] L. I. Grange and J. P. Fox: 'Soils of the Lower Cook Group', *Soil Bureau Bulletin No. 8* (N.S.), Wellington, 1953.

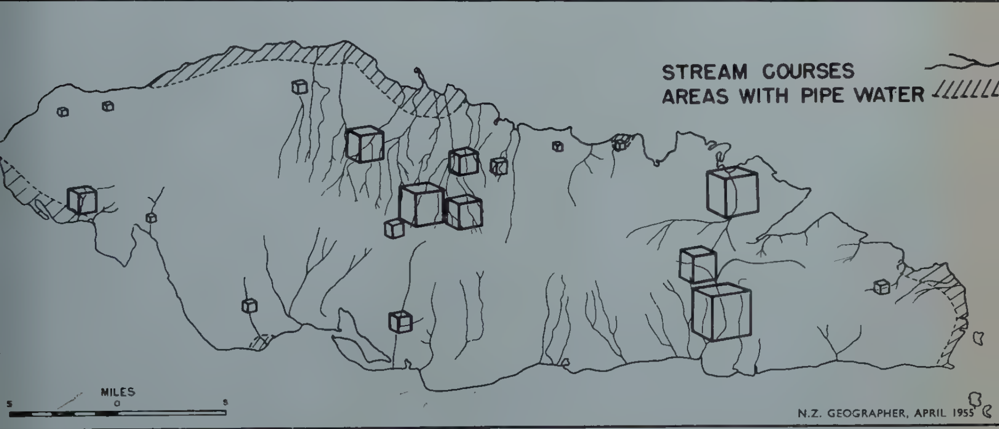


Figs. 8 and 8a. Water supplies in Western Samoa. Flows are estimated.

Fortunately, not all Western Samoa has these characteristics. In the areas of older rocks, found mainly along the main ridges and in the Tafua and northeast Upolu high areas, surface streams do occur. It seems likely that their development is the result of soils there attaining a relatively mature stage of laterisation so that impervious layers are developed. Certainly in the central massif of Savai'i, surface streams are found in the vicinity of clay-soil layers. In general, there is a decrease in volume of surface streams between high and low areas. Quite often they disappear abruptly, at other times more gradually, and in a few favoured areas they reach the coast, although such streams may have disappeared and reappeared a dozen times during their course.

Figure 8 shows the known water supplies of Western Samoa. Other permanent streams do exist in the high parts of Upolu and especially of Savai'i, and also in the Fagaloa Bay area, but their volume of flow has not been recorded. Many stream beds have no recorded average minimum flow. These are torrent tracks which may flow only once every few years as a result of rain of exceptional intensity and duration. Many of them are former lava tunnels which have now fallen in, leaving precipitous sides.

It follows, then, that many populated areas have no running water close at hand. Many coastal villages use the high-water springs mentioned earlier; others are fortunate in being able to import piped water from further afield. The remaining villages have to rely on rain caught by the iron roofs of large buildings such as churches, and channelled into concrete tanks. During dry weather water is often in short supply. It is likely that the provision of piped water to deficient areas will be extended by using the untapped, virtually unknown streams of the uplands. There seems no reason, for instance, why water from the central areas could not be piped down the long, easy slope to the densely populated Fa'asalele'aga district. Moreover, sufficient flow exists to provide hydroelectric power—as is obtained from the stream behind Apia. Some populated districts, however, notably western Savai'i, have no supplies within easy reach.



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Conclusion

Western Samoa is in a process of rapid change of technology and of social systems and values. The spread of the money economy and of Western skills and ideas, the increase in specialisation of production for overseas markets, and the ending of local isolation are all implementing change. New crop areas and new methods are appearing, and this tendency is likely to increase. The future of the material wellbeing of Samoans is dependent on increased production from the land, and knowledge of the land is the very basis of all development. The working knowledge of his village land possessed by the Samoan sufficed for his traditional economy, but for new crops, methods and areas he needs advice. Even more does the administrator and adviser in such a country need knowledge of areal differences to aid him in overall planning and in tempering recommendations to suit local conditions. Western Samoa, like other small Pacific island groups, is too often regarded as a homogeneous unit. It is hoped that this paper, in summarising the present state of knowledge, will by its very inadequacies be a reminder of what remains to be done.

THE VILLAGES OF THE MANAWATU

GRANT ANDERSON AND HARVEY FRANKLIN

> The farm people never dwell together in villages from which they go out at morning to work in the fields, returning again at dusk. The villages of Europe, noisy and picturesque at dawn and evening, silent and half deserted during the long day, have never been reproduced in the colonies.
>
> —W. Pember Reeves

FOR the purpose of this study the area between the Rangitikei River in the north and Paekakariki in the south has been called the Manawatu Plain, with the Tararua Ranges as an effective eastern and southern limit. The northern boundary is less definite. In the east, the greywacke ranges of the Tararuas stretch from Paekakariki, where they are cliffed by the sea, northwards to the east of Ashhurst, and between them and the sea are a number of major physiographic units roughly parallel to the coast, all widening to the north. This pattern is significantly altered in the north where, between the Rangitikei River and Feilding, and between Bunnythorpe and Ashhurst, are situated two low domes of sedimentary sandstones with their axes parallel to the ranges. These give rise to downland on which fat-lamb rearing with a little dairying is practised, and where nucleated settlement, with the exception of Halcombe, is found only on the periphery.

The pattern of the rest of the plain is fairly simple. Immediately behind the strandline lies a large area of swampy peat and sand-dune country which contains little settlement or roading. It is used extensively for grazing sheep and, occasionally, dry cattle; but where the flats of the lower Manawatu River have been drained the land is farmed more intensively. Along the strand itself, almost continuously from Paekakariki to Waikanae, and in isolated groups further north, are situated recreational beach settlements, a product of the motor age, composed of a large number of 'baches' built by city dwellers as places in which to spend their weekends. These settlements are fast becoming places of permanent residence and are already an important aspect of the settlement pattern of the Manawatu. They have influenced the character of some of the older villages like Waikanae and Paraparaumu considerably. Between the peat and sand dunes and the ranges lies a second band of country which is the most significant area for farming and settlement in the Manawatu. It is composed of alluvial fans and of sandstone areas which become more important in the landscape north of Otaki. Some of the fans are no more than small piedmont fans which provide suitable sites for the sheep station homesteads; but the Waikanae, Otaki, and especially the Manawatu, rivers have built extensive fans which provide considerable areas of near-flat land. Both dairying and fat-lamb farming are important in the area and have resulted in a high frequency of settlement. The establishment of dairying in the area is significant to the villages, for the dairy farmer, being more closely tied to his farm because of milking times, uses village services more frequently than the sheep farmer who is able to shop in the larger centres. The ranges are the last of the physiographic units. The lower and more accessible ridges carry store sheep and cattle; the higher country is still in bush.

Pattern of Settlement

Associated with the Manawatu is a hierarchy of urban settlement. (See Figure 1.) At the head are the cities of Wellington and Palmerston North which act as regional centres whose influence is not solely confined to the Manawatu. Below these rank the market towns of Feilding and Levin, and the smaller market centres of Otaki, Foxton and Shannon.[1] While Wellington and Palmerston, and to a certain extent Feilding because of its important stock sales, provide services which cannot be found elsewhere, the other towns have much in common. They are primarily market towns with prosperous retail shopping areas. There, too, are found professional groups, branches of banks, insurance and finance companies, stock and station agencies, the higher grade schools and other social services, county and borough offices, and some secondary manufacturing. While some towns are larger than others, they all tend to offer the same range of services; though differences exist in the number of establishments offering the same service and in the size of the establishments. All have large residential areas, and all are incorporated.

Between this group of urban settlements and the dispersed homesteads of the farming community is a considerable number of small nucleated settlements, the populations of which vary in size from about

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[1] Estimated population, 1 April 1953: Wellington (urban area) 137,600; Palmerston North 35,000; Feilding 6260; Levin 5350; Marton 3710; Otaki 2790; Foxton 2340; Shannon 1090 (*N.Z. Official Year-Book 1954*).

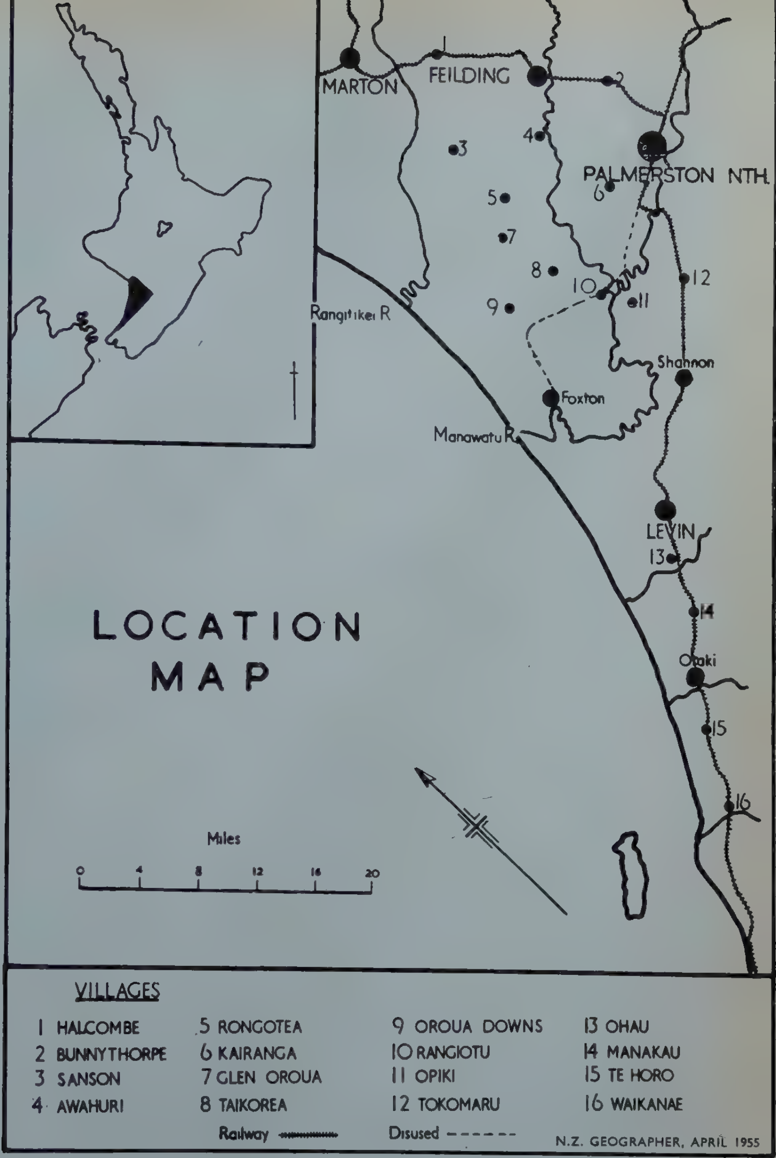

Fig. 1. The villages of the Manawatu.

twenty persons to no more than 400. For present purposes these have been called villages,[2] and have been classified, according to the number of service units present, in three groups: primary, secondary and tertiary. In many cases the primary villages are no more than a centre for the social needs and activities of the surrounding farming community, and consequently they may be regarded as part of the rural settlement pattern. To characterise the other two groups of villages is not so easy. In one sense they are still part of the rural settlement pattern, for the social activities of the farming groups are also located within them, and to a great degree their economic life and development are closely linked to those of the rural community. The layout of the villages and the occupations of their inhabitants are, however, distinctly urban, the virtual absence of any members of the farming community residing within the village emphasising the fact; but they are not large enough to possess all the characteristics of an urban settlement and community. Thus they are rural but non-farm, urban but not fully urban, and, standing between the larger groups of the rural and urban communities, they are open to influences emanating from both groups. The functions of these villages, however, best exemplify their nature, for they act principally as servicing and trading, distributing and collecting centres. In this sense they can be regarded as the first rung in the urban hierarchy.

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[2] 'Village' and 'hamlet' are the only convenient words in the language for use as general terms to describe these small nucleated settlements. Rather than introduce the difficulty of distinguishing between the two it was decided to refer to all settlements, regardless of variations in size, as villages. This word inevitably carries with it a number of associations, and it seems necessary to stress that when applied to New Zealand these associations must be disregarded. For instance, whilst the villages are nucleated, the houses do not have that compact wall to wall arrangement found in many English villages, and their urban character is emphasised by the almost complete absence of farm houses within the nucleation. The Manawatu village originated in a very different cultural milieu from that in which the English village arose, and this alone goes far to explain the obvious differences, and suggests that the Manawatu village is a significant 'colonial' form of settlement.

CLASSIFICATION OF VILLAGES

The following criteria were used to determine which settlements could be classed as villages: (1) the settlement should have no town board or borough council, which in New Zealand, with some exceptions, means the population will be less than a thousand persons, and in most cases considerably less; (2) a degree of nucleation should be apparent; (3) there should be no less than two buildings used for social or commercial purposes. It is difficult to determine exactly the size of the population of any of these villages. The figures for localities given in the first volume of the *Population Census* and the maps showing mesh blocks are generally unsuitable. While it is possible to estimate the population of the smaller places using an average number of persons per household, experience so far has been that with larger villages the errors with this method may be considerable.

A most significant differentiation between the villages, apart from size, is the number of service units which they possess; and as differences in size of population tend to be related to numbers of service units, the villages have been classified according to the number of service units present. Each service unit—a school, hall, garage, or dairy factory—has been allotted one point, with the exception of commercial retail units which have been weighted by the allotment of two points. This weighting was considered realistic since the same social units are found in every village, and it has been the retail units which have suffered most in the competition with the towns. Consequently, the more numerous the retail units the greater the importance of the village in the local area. Furthermore it is easier to make an assessment of the economic than of the social, importance of a village.

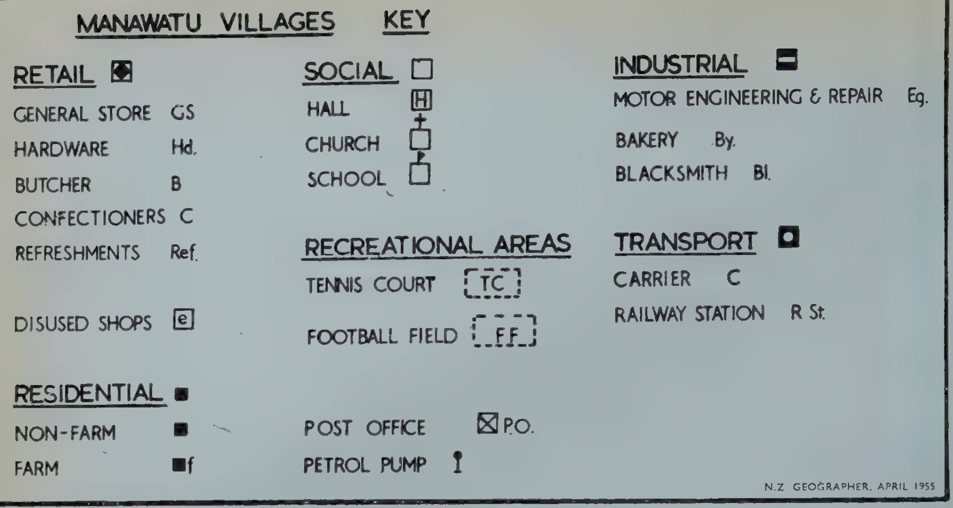
This is the basis of the classification into the three groups, primary, secondary and tertiary. The primary group is the smallest in size of population and possesses in many cases only social units; the tertiary group is the largest in number of persons and of economic and social units. There are, however, a few settlements which cannot be classified in this fashion and cannot be called villages, but which nevertheless are part of the settlement pattern, and which may with time rise to the status of villages. These have been placed in a fourth group. (See Table I.) Two examples will suffice. It is common in the Manawatu to find a settlement composed of a dairy factory with the residences of the workers grouped near it. With the development of motor transport another type of settlement consisting solely of retail units has arisen. Himatangi Corner consists of a garage with an eating-house

TABLE I

CLASSIFICATION OF MANAWATU VILLAGES

Form	Primary	Secondary	Tertiary	Special
Road Junction	Kairanga Glen Oroua (d) Taikorea Opiki	Awahuri (b)		Himatangi Corner
Shoestring	Oroua Downs (bdx) Rangiotu (bdx)	Te Horo (abd)		Awahuri (d) Kuku (d) Ngamora
Grid Pattern	Ohau (ab)	Manakau (ab) Bunnythorpe (abd) Waikanae (ab)	Sanson (b) Rongotea (d) Halcombe (a) Tokomaru (abd)	

(a) on railway line
(b) on main highway
(d) with dairy factory
(x) situated on railway line not in use



Key to village maps, Figures 2, 3 and 4.

and residence attached, and a store with an attached residence, both situated on a crossroads.

The primary village is characterised by its small number of houses and other service units generally grouped around a road junction, and perhaps having a tendency to ribbon along one of the roads. In some cases there are no shops whatsoever. Kairanga, the classic example, is a crossroads with a school, hall and church, catering for the inhabitants of the surrounding farms, together with a few houses and a carrier's yard. Glen Oroua has a post office and exchange, a school, hall and small dairy factory (*Fig.* 2).

SECONDARY AND TERTIARY VILLAGES

Whereas primary villages have just grown up around road junctions, the secondary and tertiary villages are characterised, apart from the greater number of service units, by their distinctive gridiron road patterns (*Figs.* 3 and 4). While only one street may be sealed and the others are no more than metalled roads or dwindling grass or dirt tracks, the feel and intention of a town is there. Even a main street can usually be picked out, although the few commercial units are often interspersed with dwellings, empty shops, churches and vacant lots. Along the side roads straggle the other residences, and here the halls and the school are found.

The houses, with few exceptions, are unattractive wooden buildings of one storey, oblong or square in shape, painted a dirty yellow, with a red corrugated-iron roof, possibly a verandah at the front, and certainly a rainwater tank at the side or back. They stand dourly in the middle of their sections of one half-acre or less, facing the road,

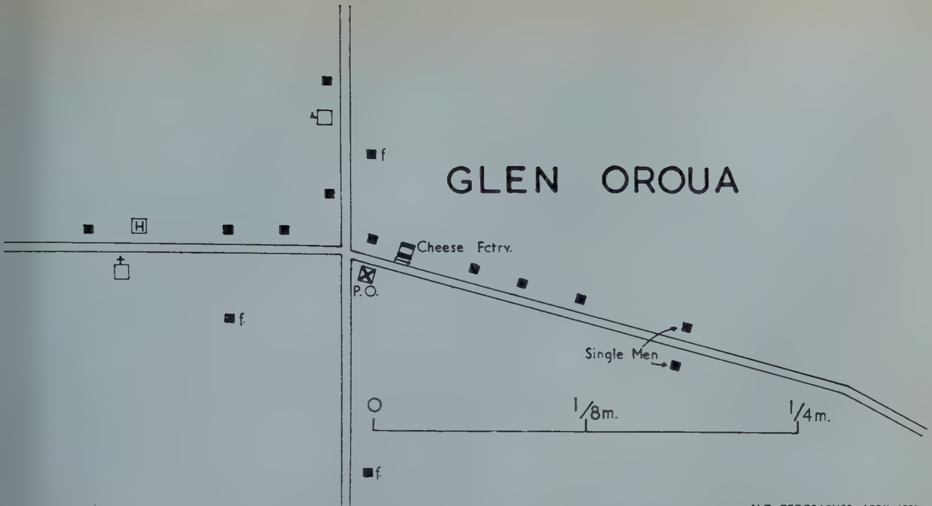


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Fig. 2. Glen Oroua: a primary village.

not the sun, their gardens often poorly tended. Yet they are comfortable and substantial, all have electricity laid on, but no piped sewerage or water. Three distinct groups of dwellings can usually be picked out: the railway houses, the postwar state houses, and the single men's quarters of the dairy factory. The railway houses are grouped adjacent to the line, on Crown land, and are about sixty years old. The state houses still retain the square ground plan, but differ from old types in the internal arrangements of rooms and in having tiled instead of corrugated-iron roofs. The single men's quarters are small huts. Occasionally modern dwellings have been built since the war. They do not conform with tradition—they are not painted yellow, in plan are often L-shaped, and they face the sun.

The churches do not have that architecturally dominating and unifying role of the English parish church, for they do not represent the efforts of organised ecclesiastical bodies but the work of local groups, who, in the early days, led by their lay preachers, held their meetings in the open or in private houses until opportunity came for them to build their own place of worship. The village school, with the teacher's house adjacent, has a characteristic layout and appearance. For amenities it often has a basketball and tennis court. It caters for the village children and for those of the surrounding farms who are often collected by the school bus driven by the teacher, or arrive themselves on horseback or on foot. Above the primary level the child must go to the towns for his education.

The number of clubs and activities which are carried on in these villages is surprising but their support, it appears, comes largely from the local farming community. The school, the memorial hall (usually built after the 1914-1918 war), the returned servicemen's clubrooms, and the occasional Methodist Youth Centre are used practically every night. The English 'pub' and village green with their important social roles find few counterparts in the Manawatu villages. In the rigid ground plan of the secondary and tertiary villages provision has been made for a square with a memorial rather than a green. In Bunnythorpe there is even a memorial park—a very urban feature. Only five of the settlements have hotels—Awahuri, Sanson, Halcombe, Bunnythorpe and Manakau. In the case of Rongotea provision was made at the beginning of the settlement that no licence should be granted in the area. Where there is no hotel, drinking is either done

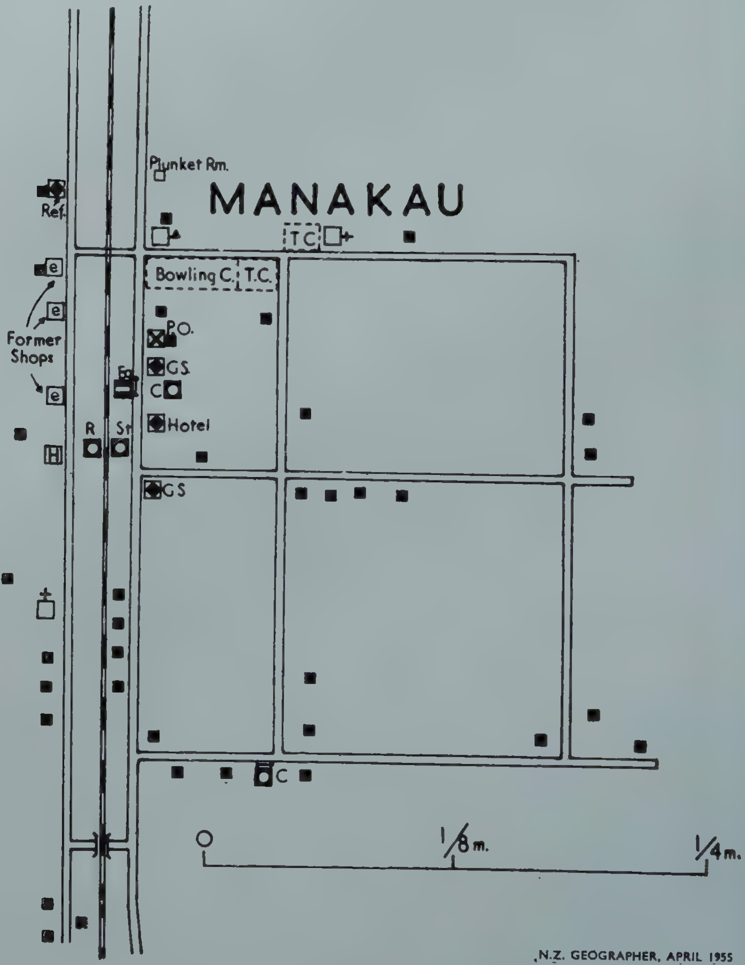
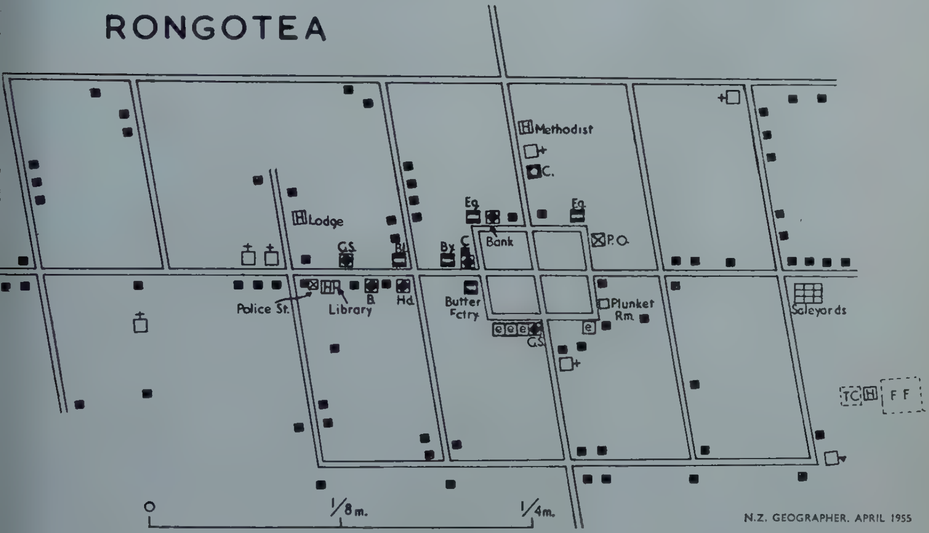


Fig. 3. Manakau: a secondary village.

in the home, or the motor car is used to visit the nearest town. Amongst the younger people especially, social needs are tending to be satisfied in the town rather than in the village.

Village Occupations

One or two general stores with a petrol pump, a butcher and a baker comprise the retail units of these villages. The general store offers many services other than the sale of goods (*Fig.* 5). Although it was the custom earlier to have the post office combined with the store, it is now housed in a separate building. The number of empty shops now used as residences indicates the loss of services which the villages have suffered since the introduction of the motor car. The needs that cannot be satisfied in the village are now met by the towns, most villages lying on a bus route with an infrequent service. Occasionally along the main highway fresh-vegetable stores and tearooms have appeared. Saleyards are in use at Waikanae and Rongotea, but at other settlements like Awahuri they have disappeared. The dairy factory, the garage where repair work is undertaken, and the carrier are the most common aspects of industry found in the villages. In some a local builder, plumber, carpenter and blacksmith reside. In five of the villages small manufacturing plants are located. At Waikanae there is a paint factory, at Te Horo a one-man tile factory, at both Rongotea



N.Z. GEOGRAPHER. APRIL 1955

Fig. 4. Rongotea: a tertiary village.

and Tokomaru toymaking has been established, and at Halcombe there is a small concrete-products factory.

Investigations in four representative villages[3] served to demonstrate some of the salient characteristics of the inhabitants themselves and to emphasise the functional aspects of the settlements.[4] The occupations of the male villagers are listed in Table II. This table demonstrates the significance of the village as a trading, servicing and distributing centre. Excluding the thirty-two retired males, the thirteen who are employed in other centres, and the one unemployed, 166 males are left, of whom nearly eleven percent are engaged in retail, wholesale and commercial activities, and approximately twenty-five percent are engaged in transport—a total of sixty persons. To obtain a more accurate picture of the numbers engaged in trading with, or servicing, the farming community the following must be added: six agricultural contractors, thirteen dairy-factory employees, four garage workers, four bakers, one blacksmith and ten builders, plumbers and carpenters —a grand total of ninety-eight males, or 58.5 percent of the total employed. After this group come the males directly engaged in agricultural pursuits, 14.5 percent, and those engaged in social or administrative tasks, 8.5 percent.

INDUSTRY IN THE VILLAGE

It will be appreciated that most of the industry in the village is very closely linked with farming, and where the connection is less close the industrial plants tend to be located outside the village. Thus the textile workers are employed at a mill some three miles from Halcombe and the meat-factory workers travel to the environs of Palmerston North or Feilding. Only at Waikanae, where a paint factory is established, can it be said that a real example exists of industry decentralised to a village. Retired males are important, and a fair proportion of this group is made up of people who have left the larger centres, attracted by the lower land values, the lower cost of living, and the easy peaceful life to be found in the villages. As dormitories for the bigger towns the villages surveyed are as yet unimportant.

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[3] These are secondary and tertiary villages. Primary villages proved to be too small for significant characteristics to emerge.

[4] Questions were restricted to the age, sex and occupation of each member of a household, and the length of residence of the head of each household. Interviews totalled 188 and concerned 714 people, 212 of whom were males. The majority of the women gave their occupation as housewife. Only one married woman—a schoolmistress—was employed outside the house, whilst the single women, usually adolescents, were post office employees, clerks or shop assistants.

TABLE II

OCCUPATIONS OF MALES IN FOUR MANAWATU VILLAGES

Occupational Groups	Rongotea	Halcombe	Tokomaru	Te Horo	Totals
Agriculture					
Farmers	–	7	2	1	10
Market gardeners	–	–	–	2	2
Farm labourers	4	5	1	2	12
Agricultural contractors	1	3	2	–	6
Industry					
Dairy factory employees	11	–	1	1	13
Garage owners and employees	3	1	–	–	4
Bakers	2	2	–	–	4
Woollen mill employees	–	5*	–	–	5
Cement and tile workers	–	4	1	1	6
Stone and gravel workers	–	2	–	–	2
Meat factory employees	1*	2*	–	–	3
Toymakers	2	–	1	–	3
Blacksmiths	1	–	–	–	1
Building Construction and Maintenance					
Builders, plumbers and carpenters	6	2	3(1*)	–	11
Public works employees	1	1	1	–	3
County employees	8	–	–	–	8
Transport and Communications					
Motor transport and carriers	9	4	1	3	17
Railway employees	–	10	8	7	25
Post and telegraph employees	1	–	–	–	1
Commerce, Retail and Wholesale Stores					
Shopkeepers and assistants	5	5	2(1*)	1	13
Bank clerks	–	1*	–	–	1
Stock agents	2	–	–	–	2
Produce merchants	1	–	–	–	1
Hotel proprietors and employees	–	3	–	–	3
Professional, Educational and Administrative Activities					
Post office officials	2	2	–	–	4
Clergymen	1	2	–	–	3
Schoolmasters	1	1	1	1	4
Policemen	1	–	–	–	1
Veterinary surgeons	1	–	–	–	1
Electric powerboard employees	1	–	–	–	1
Government clerks	–	–	1*	–	1
Others					
General labourers	–	3	2	–	5
Opossum trappers	–	1	–	–	1
Taxi drivers	–	1	–	–	1
Unemployed	–	1	–	–	1
Not specified	–	–	–	1*	1
Retired	1	16	13	2	32

* Place of employment outside the village.

In the villages the proportion of the population in the adolescent group was remarkably low. (See Table III.) The explanation of this, it is presumed, lies in the migration of the adolescent to the towns because of insufficient openings for employment in the village itself, and the preference for the occupations and social life offered by the towns in comparison with those of the countryside. Frequently the adults interviewed offered the same explanation, and on occasions expressed their concern at the lack of economic opportunity for the young. One mother in Waikanae pointed out that her son had to choose between becoming either a plumber or a railway employee, or migrating to the city for employment. Table III shows that between each village there are variations in the proportions contained in each age group, and between different towns and different counties within the Manawatu similar variations are to be found. While they should not be overlooked, these local variations do not materially affect the general picture, though a larger statistical survey might help to remove any doubts which remain.

TABLE III

PERCENTAGE OF POPULATION BY AGE GROUPS★

	Rongotea	Tokomaru	Halcombe	Te Horo	All Four Villages
0– 5	17.5	10.7	12.5	19.3	14.8
5–15	19.5	16.4	20.9	26.8	20.5
15–25	8.4	9.9	9.7	4.3	8.5
25–65	51.0	44.1	43.2	46.4	46.6
65+	3.6	18.9	13.7	3.2	9.6

	All North Is. Counties	All North Is. Boroughs	All Manawatu Counties★★	All Manawatu Boroughs	All Four Villages
0– 5	15.1	10.7	13.0	11.9	14.8
5–15	22.6	17.2	21.5	18.5	20.5
15–25	12.6	12.4	13.7	12.3	8.5
25–65	43.5	49.4	44.3	46.8	46.6
65+	6.2	10.3	7.5	10.5	9.6

★ Based on 1951 census returns.

★★ The high 15-25 group figure results from the large percentage of adolescents in Kairanga County, to which Palmerston North is adjacent. It is presumed that many adolescents residing in Kairanga County work in that city. The percentage for the other three counties, Oroua, Manawatu and Horowhenua, is roughly the same as that for the North Island counties.

From the time of their founding to the present day these villages have acted as the first and most immediate link between the isolated

Fig. 5. Waikanae: the village store.

farmsteads and the larger towns and ports, and have played a significant part in the economic system of the dominion. At these points the rural community bought and sold, railed its stock, received its goods and found it convenient to locate its social activities. Arising thus, from the social and economic needs of the people, the villages have been influenced in their development by changes which have taken place in the life of the community. The opening-up of the North Island especially is closely related to the building of the main trunk railway. These villages in the Manawatu were located along the line, and each acquired an area tributary to it in an economic sense, the boundaries of the area being related to the limits of horse-drawn transport. Consequently, the villages were numerous and frequent. In addition to commercial and social activities, industries associated with the exploitation of the region as a whole were often sited within the settlements. Today, however, the development of the motor car has particularly affected the future of these settlements. It has destroyed the arrangement of tributary areas about the villages and given economic advantage to the larger towns. In detail these changes fall conveniently into three periods, the features of each tending, of course, to overlap.

Origins and Growth

In 1870, settlement in the Manawatu, with the exception of such coastal localities as Foxton and Otaki, began late, the first settlers arriving at Palmerston North in 1871 and at Feilding in 1874. Like other parts of New Zealand, the settlement of the region was characterised, not by the efforts of individuals to break in the land, but by the work of organised groups. These bodies purchased a block of land from the Crown, surveyed the area and laid out townships to act, in the beginning, as centres from which the exploitation of the area might start, and later, as commercial centres. They sought the provision of, or themselves provided, a railway line so that the settlement of the district might be facilitated and the produce of the area exported. Finally they were responsible to some extent, by agreement with the government, for seeing that sufficient settlers were introduced to develop the block. In 1878 the government sold 40,000 acres to the Douglas Company which laid out Campbelltown (now Rongotea) as its township. Sanson was the township of the block developed by the Hutt Small Farmers Association, while the settlement of Halcombe was undertaken in 1876 by the agents of the Manchester Block. Most of the villages south of the Manawatu River were developed by the Wellington-Manawatu Railway Company. One can see in these developments that the villages originated as urban centres and their layout is thus understandable.

Influence of the Railway

The development of Bunnythorpe illustrates the influence the railway could exert on the development of the villages. In anticipation of the Napier line joining the Foxton-Palmerston-Wanganui line in the vicinity of Bunnythorpe, sections were sold upon the understanding that that site would be chosen as the junction. (In the end Palmerston North was preferred.) The probability that the Wanganui line would be completed before the east coast line influenced agents of the Manchester Block to proceed with the development of Halcombe in preference to their other proposed township at Ashhurst.[5] The importance of the railway line in the development of these settlements and of the region as a whole is most clearly illustrated by the absence of any railway to Sanson, a fact which caused the inhabitants of the district to support before the Railway Commission the case for a west coast line from Wellington to Foxton and also the connection of Sanson to Foxton.[6] Part of the task set the commissioners was to consider and recommend on the connection of Wellington with Palmerston, either through the Wairarapa and by way of the Manawatu Gorge, or by the west coast. In 1880 the area south of the Manawatu River, with the exception of Otaki, Waikanae, Paekakariki and some areas of Maori land leased to pakehas, contained few Europeans. Those in favour of the west coast line spoke of the fertility of the area but were unable to win the support of the commissioners for their projected line. A private company, however, undertook the project, and in 1886 the Wellington-Manawatu Railway was completed, and it was not until after this date that most of the villages south of the Manawatu River were founded and developed by the company.

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[5] T. A. Gibson: *The Purchase and Settlement of the Manchester Block*, Feilding, 1936, pp. 45-46.
[6] See *Append. Journ. House of Repres.* (E-3), 1880, p. 7.

With roading so inadequate and the rivers unsuitable for traffic on a large scale, the railway was a great boon to the region, and the villages rapidly developed as distributing and collecting centres. Practically all the land was covered in bush, and timber milling, together with the flax industry, became important activities of the villages. In 1887-1888 the Wellington-Manawatu Railway carried 520,000 sawn feet of timber. In 1896-1897 the amount was 8,340,600 sawn feet, the highest figure recorded in the history of the company. The amount of flax carried in 1888-1889 was 218 tons, and the next year the figure rose to 2200 tons, a total never to be repeated.

Village Services Established

During this early period when the country was being broken in, the villages acquired many of their services, some of which remain to the present day. The post office, originally attached to the local store, and later housed in a separate building, was of course one of the first. Most villages had a public school erected soon after the first settlers arrived—that at Rongotea was opened three years, and that at Halcombe four years, after the arrival of the first settlers. Churches were generally built later, each denomination having to acquire sufficient numbers and wealth before building. It is doubtful whether many halls came into existence until after the 1914-1918 war, since so many are memorial halls; however, as early as 1888 the Bunnythorpe Public Hall Corporation had erected its building. Accommodation houses, if not hotels, were more numerous at this time than today. In 1897 Halcombe is recorded as having two boarding houses (the existing hotel is not mentioned). In the same year Rongotea had one boarding house; and during the important days of the flax industry, Tokomaru possessed two accommodation houses. Simcox records that Manakau had two hotels during the 'nineties.[7] These commercial houses not only catered for the traveller but also for the large floating population of sawmillers, flax workers, and road contruction men. Two or more general stores were common in the villages, as were the farrier and blacksmith, the butcher, the baker, the bootmaker; and on occasions a coachbuilder and wheelwright, and harness and saddle maker could be found. The billiard saloon was a common place of amusement. Most settlements possessed stockyards, and sales at regular intervals were held.

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[7] F. S. Simcox: *Otaki, the Town and District,* Wellington, 1952.

During the 1890's these villages appear to have been prosperous, earning their livelihood by servicing both the agricultural and industrial populations. Although roads did connect some villages with others, the transport of most goods was still so difficult and costly that in effect the villages were comparatively isolated. This meant that each settlement possessed a tributary area which helped to support it and from which it drew its customers. The railway was the lifeline of these villages, ensuring their prosperity and influencing their location. Only the smallest had arisen by chance or circumstance; the larger ones had been planned; and given the existing means of transport, and so long as the district suffered no economic setback, their future seemed full of hope.

Development of the Dairy Industry

It was inevitable that the timber resources of the area would be cut out eventually, and by 1896, the timber trade of Halcombe was already falling off. The flax industry, too, was to decline because of disease and of the drainage of the growing areas, though its decline took place later than that of the timber industry. But before the effects of these changes were felt, the Manawatu and its villages received a boost from the development of the dairy industry. This new industry produced an increased density of settlement within the region, and in many cases meant the establishment within the villages of a dairy factory which provided employment both for builders and factory workers, and which strengthened the position of the villages as foci of movement for the neighbouring farm people. Factories were established remarkably quickly—at Rongotea in 1893, and in the next year at Sanson, Tokomaru and Te Horo. In other cases, because the slowness of horse-drawn transport limited the collection area of the dairy factory, they were sited not in the village, but at a convenient road junction. During this second period from 1890-1920 the settlements must have been at the height of their prosperity.

After the 1914-1918 war a number of social, economic and technological changes became evident, which, if they did not change the culture of the people, seriously modified it, and in turn affected in diverse ways, but generally to their detriment, the status of the

ɀ. 6. Tokomaru: a former boarding-house—a relic of flax-milling days.

Fig. 7. Rongotea: abandoned shops—an index of urban competition.

villages. The farming community enjoyed an improvement in their standard of living and they tended to demand a greater range of specialised goods, which the village stores were unable to stock. Fashion became an influence in the lives of both men and women, who, no longer content with the rude clothing supplied by the local store, selected their best clothes from the shops in the larger centres. Fashion also entered the home, and electrical goods, furniture and furnishings were mostly purchased in the towns. The increased mechanisation on the farms again detracted from the importance of the village, for the salerooms of firms dealing in milking machines, tractors, haymakers and other such implements were necessarily centralised. The motor car, with the accompanying improvements in roads, was the tool of the changes, since it permitted greater mobility. And, of course, the commercial men of the larger centres themselves influenced these trends by consciously offering a greater range of goods.

Some of the changes which took place within the village were inevitable. With the decline in importance of horse transport, tradesmen associated with it disappeared. But in a sense their role was filled, in secondary and tertiary villages, by the garagemen, who not only serviced the cars but did engineering and repair work; and the petrol pump and the rack of lubricants became familiar adjuncts to the general store. The local carrier and contractor still remained, but were mechanised. The accommodation houses fell into disrepair or were converted (*Fig*. 6). This was partly attributable to the demise of horse transport and partly to the decline of the flax and timber industries. In earlier times the large floating population of public works employees had provided another source of income. While a few roadmen are still housed in the villages most of the public works projects are now located in areas far removed from the villages.

The greatest loss suffered by the villages was in the reduction of the number of commercial units (*Fig.* 7). Since 1920 the following have disappeared: at Tokomaru, two boarding houses, two butchers, branch bank, and a boot repairer; at Rongotea, solicitor, boot repairer, draper, barber and billiard saloon, butcher, boarding house, tailor, general store, decorator's store, blacksmith and coachbuilder; at Halcombe, greengrocer, and general store; and at Te Horo, grocer, stationer and newsagent.[8] The social activities did not suffer so great a decline. The large number of clubs and organisations which still exist has already been mentioned; but nevertheless even though films are shown regularly in the villages themselves, the attraction of cinemas and dance halls in the larger centres is great.

Recently-acquired Functions

These latest trends did not mean decline in status for some villages. On the main highway some acquired service units, especially in the form of refreshment rooms or milk bars, which cater for the through motor traffic. At Himatangi Corner and Linton crossroads the establishment of these types of commercial activity is giving rise to a new type of settlement—one created by the motor car and largely dependent upon it for its trade. The greater mobility permitted by the use of the motor car has led, in the case of Waikanae, to the creation across the road from the original village of a new settlement, inhabited by retired business people and Wellington commuters. Since the war small manufacturing plants have been established in some villages, but such gains do not fall equally upon all settlements.

With these exceptions the trend over the last few decades has been to reduce the importance of these villages. Previously they played a significant role in the development of the area, especially during the period of difficult transport. It is hard to speculate about their future. One cannot see them losing entirely their social importance and what little economic significance they now possess. It is likely that some, with their advantages of climate, location, or building sites, may grow and prosper; but such possibilities are governed by a host of factors over which the village communities themselves have little control or influence. But the majority seem destined to remain vestigial forms derived from an earlier cultural milieu, until perhaps some further technological change, as startling and portentous as was the advent of the motor car to earlier generations, once more influences their fortunes.

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[8] These lists were compiled from the recollections of old inhabitants, each checked against the others.

The present-day Manawatu village functions primarily as a trading and servicing centre for the surrounding farming community. In addition it plays an important social role as a meeting place in the day-to-day activities of these people, and as a centre where their social activities are located. It serves also as a place of retirement for the elderly. Yet the villages have problems of their own. They are particularly susceptible to any influences originating in either the rural or urban communities, and consequently are subject to frequent changes, while the apparent migration of their young people to the towns inevitably lowers the vitality of village life. The motor car does more than detract from the commercial life of these settlements—it whisks the geographer through at such a pace that he has almost overlooked their existence. Yet these villages are a ubiquitous form of settlement in New Zealand. To the geographer and the social scientist they offer a stimulating and, as yet, largely untouched field of research,[9] which, if undertaken, will have considerable practical value.

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[9] Initial geographical research in this field was undertaken by one of the authors in 1952. See A. G. Anderson: *Rural Villages of Otamatea, Rodney and Waitemata Counties; A Study in the Geography of Rural Settlement,* unpublished M.A. thesis, University of New Zealand, 1952.

FOSSIL GULLIES IN THE WELLINGTON LANDSCAPE

C. A. COTTON AND M. T. TE PUNGA

AMONG features of the superficial, or Pleistocene, geology of Wellington that have been long familiar to many geologists and geographers, though none has ventured to explain them, are 'fossilised' gullies that are seen in cross-section in many road cuttings (*Fig.* 1). They are V-cut gullies, similar apparently in most respects to the host of other gullies that still remain open, dissecting and draining the broader slopes of the landscape. They differ from these only in that they are filled with head, or 'slope deposits' as the material has been conservatively called, when encountered in field excursions, without any real attempt to explain its provenance or the agency that has been responsible for transporting and depositing it. This material has recently been recognised as true head,[1] the hitherto puzzling immobility of which at the present day may be explained by the rapid drying-out of a slurry of debris, probably a few thousand years ago, at the close of a periglacial episode contemporaneous with the last glaciation of New Zealand. Prior to its rather sudden arrest this mixture of fine and coarse fragmentary material and water was mobile enough to stream down even very gentle slopes. It is claimed that similar mixtures in Europe were mobile on slopes with declivities as low as two degrees.

It has been inferred from the geological evidence afforded by superficial deposits that in central Germany the mean temperature was lower by ten to thirteen degrees centigrade during the last ice age than it is today. Mortensen,[2] in an attempt to explain this, has arrived at the generalisation that many districts not actually glaciated—possibly districts bordering glaciated mountains, though this does not seem entirely necessary—had their temperatures reduced during the glacial ages, with frequently recurring inversions of the thermic gradient, considerably below those of contemporaneously glaciated mountains. In such regions the air would be clear and dry in ice ages, as is now commonly inferred in Europe; and something of this kind may be pictured in southern Wellington. Low enough temperatures must have prevailed at any rate to freeze the ground to some depth during winter, and for

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[1] Te Punga in C. A. Cotton and M. T. Te Punga: 'Solifluxion and Periglacially-Modified Landforms at Wellington, New Zealand', *Trans. Roy. Soc. N.Z.*, Vol. 82, 1955, pp. 1001-1031.

[2] H. Mortensen: 'Heutiger Firnrückgang und Eiszeitklima', *Erdkunde*, Vol. 6, 1952, pp. 145-160.

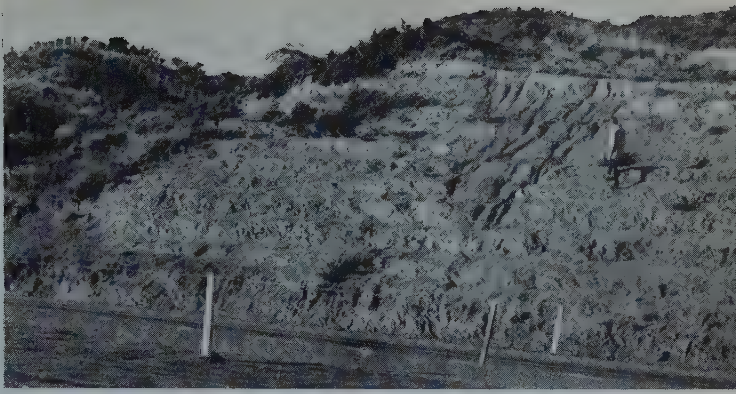

Photo: M. D. King

Fig. 1 A fossil gully seen in cross-section in a cutting on the motorway, eastern si of the Porirua Valley, Wellington. The gully is cut in yellow-brown weather greywacke and is filled with darker brown, gravelly head which is not water-wor Choking of the gully with head has caused diversion of drainage and inversion of reli

a period there may have been a general development of perennially frozen ground. It must have been the impermeability of ground ice (tjaele) that kept temporarily thawed surface material saturated with water and promoted a streaming of the regolith (solifluxion). This is not to be pictured as comparable in velocity to sporadic ‘earth flow’ in temperate regions; but solifluxion with velocity of the order of four inches per summer has been observed on islands north of Canada.[3]

While the former (preglacial, or preperiglacial) regolith streamed away, an enormously increased activity of weathering by freeze and thaw (gelifraction) abundantly produced further debris, both coarse and fine. This must have flowed in summer as a slurry down slopes and in concentrated streams along the axes of gullies. Such flow is checked immediately on gentle slopes, however, if the streaming debris loses its water content—as it will if the mean temperature rises and ground ice melts away, for this allows infiltration of the water into the ground beneath. This is the recognised origin of superficial ‘head’, which is now relatively immobile. Loss of water has converted it from a condition equivalent to that of a plastic solid to that of an ‘elastic continuum’.[4]

It seems that in some regions gullies have been enlarged by a process of corrasion under soliflual (that is, solifluxional) debris streams; but this may be exceptional, and certainly many Wellington gullies have retained a narrow v-shape, indicating that in their case such lateral enlargement has been negligible. It can happen, apparently, that a narrow gully becomes choked by soliflual debris, which then fills it to the brim. It may be that in such cases at Wellington a free draining away of water, because of the shape of the gully, perhaps, or the thinness or absence of ground ice along the line of the gully, has robbed the fill of its mobility, and so it is possible to explain the 'fossilisation' of some gullies even *during* the periglacial age.

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[3] A. Cailleux and J. Tricart: ‘Une type de solifluction: les coulées boueuses’, *Rév. Géom. Dyn.*, Vol 1, 1950, p. 37.

[4] A. N. Strahler: ‘Dynamic Basis of Geomorphology’, *Bull. Geol. Soc. Amer.*, Vol. 63, 1952, pp. 923–38.

It is perhaps less easy to find a plausible explanation for a common tendency towards inversion of relief, the fossilised gully being found at the crown of a spur and flanked today by open gullies of considerable depth. A hypothesis in explanation of inversion may, however, be based on the theory that considerable changes in microlandforms in rather recent, say late Pleistocene, times have resulted from alternation of periglacial with non-periglacial episodes. During the former, spurs were worn down by gelifraction and solifluxion, and all gullies became at least partly filled with head, whilst during other episodes dissection by water streams occurred similar to that which may now be seen in progress on the plateau behind Belmont, in the Hutt Valley.[5]

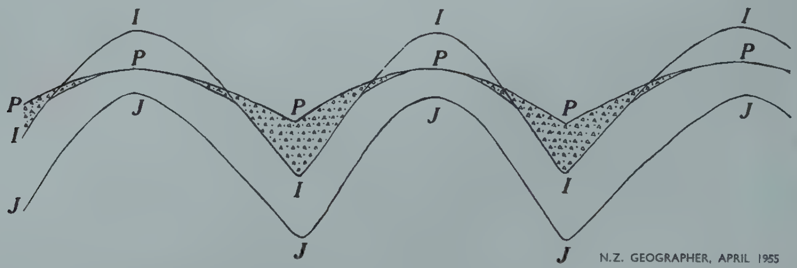

Fig. 2. Spurs and gullies of fine-textured dissection shown in transverse profile in successive phases of normal erosion (profiles *I, J*) and of periglacial development (profile *P*).

Such alternation, accompanied by a considerable net lowering of the land surface is shown in Figure 2. *I* and *J* are profiles of the surface in successive interperiglacial episodes of downcutting by water streams —though the earlier of these might equally well be the preglacial, or preperiglacial, profile, or the later might be postglacial, or postperiglacial, that is, the profile as it is today. *P* represents a periglacial profile, truncating former spurs and showing gullies partly filled with head. Such progressive levelling-down of summits is known in other periglaciated areas, notably in Poland.[6]

If at stage *P,* however, a particular gully (G, in *Fig.* 3) becomes choked with head, so that it no longer functions as an evacuating channel for a stream either of soliflual debris or of water, it will become fossilised. In such a case the stage *P* will be followed *locally* by a stage *F*, shown in the profile *F* in Figure 3, in which inversion makes its appearance. While other gullies are rejuvenated, or at least cleared of debris, by stream erosion in the next interglacial or postglacial episode (*J*), those (*G*) that have suffered inversion are not; they remain fossilised.

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[5] Cotton in Cotton and Te Punga: *op. cit.*

[6] J. Dylik: 'The Concept of the Periglacial Cycle in Middle Poland', *Bull. Soc. Sci. Lodz,* Cl. III, Vol. 3, 1952, pp. 1-29.

It is not always clear why a particular gully should become a fossil, but some may have been too narrow to function as channels for soliflual debris streams; or discontinuity of the ground ice under the gully axis may have favoured drainage and such drying-out of the debris as would immediately check its flow and prevent further evacuation through this particular channel.

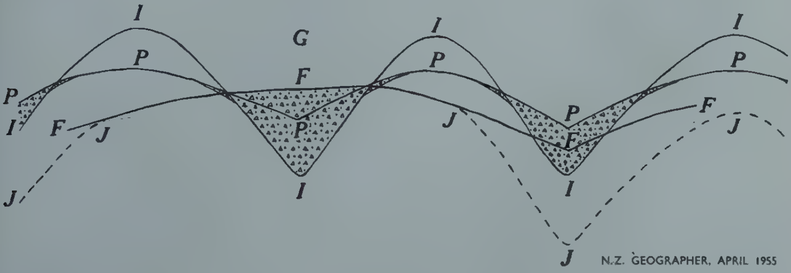

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Fig. 3. Spurs and gullies as in *Fig.* 2, except that the gully *G*, having ceased to function as a channel of evacuation, has become fossilised, thus causing local inversion of relief (profile *F*), which immunises the head in the gully *G* from erosion in later phases of gully deepening. (*I, J, P:* as in *Fig.* 2.)

If this process of gully fossilisation and inversion of relief were repeated over and over again, the gullies of one erosional episode becoming spurs in the next, and *vice versa,* the whole slope on which the gullies are incised would retreat progressively, affording an example of the slope-retreat mechanism termed 'gully gravure' by Bryan.[7]

Bryan himself raised the question of the possible influence of climatic changes on slope retreat. He seems, however, to have pictured the gully-gravure process, with its repeated inversions of spur and gully relief, as aclimatic for the most part in the type locality he described in the Southern Appalachian region of North Carolina; though it seems possible that the filling and abandonment of gullies there may have taken place only, or at any rate mainly, when periglacial conditions supervened, as has been the case at Wellington.

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[7] K. Bryan, 'Gully Gravure: A Method of Slope Retreat', *Journ. Geomorph.*, Vol. 3, 1940, pp. 89–107.

GEOGRAPHIC NOTEBOOK

CONTRIBUTORS TO THIS ISSUE. In October 1952 the *New Zealand Geographer* published an article by Dr. Donald Patton which surveyed generally the character of New Zealand fisheries, emphasising particularly their place in the world setting. Now Mr. P. D. Dibble, geography master at the Auckland Grammar School, investigates the nature of the fishery activities themselves and interprets their regional differentiation. This article is a summary of a thesis presented for the M.A. degree in the University of New Zealand and prepared by Mr. Dibble whilst a student in the Department of Geography, Auckland University College.

Perhaps one of the most significant trends in methodological thinking by geographers today is the critical examination of the very nature of the phenomena which are relevant to geographical description and interpretation. This is nowhere more obvious than in the field of physical geography, for tradition has died hard in that branch of the subject. Geographers in this country will therefore be grateful to Mr. W. H. Wallace for setting out so clearly and so succinctly his appreciation of the geographical study of landforms, and for the presentation of what must be the first map of the landforms of New Zealand classified in terms of inherent characteristics. For three years at Auckland University College Mr. Wallace was responsible for teaching and research in geographic geomorphology. He has now returned to the United States to take up a post at Rutgers University, New Brunswick, New Jersey.

Western Samoa is a significant part of New Zealand's Pacific island neighbourhood, an island group where resource and population problems have reached a critical stage. Preparatory work for an investigation of these problems by staff members of the Department of Geography at Auckland University College was carried out during the summer of 1954 by Mr. Leslie Curry, Lecturer in Geography, and his present article constitutes a summary of the physical geography of the trust territory.

Hitherto contributions to the geography of settlement in New Zealand have been confined to urban aspects, but in this issue Mr. A. G. Anderson and Mr. Harvey Franklin discuss some of the salient features of 'villages' in the Manawatu. When this article was written the authors were members of staff in the Department of Geography, Victoria University College, Wellington, Mr Franklin as Lecturer in Geography, and Mr. Grant, who has now proceeded overseas, as an assistant.

Professor Cotton needs no introduction to geographers and geologists in New Zealand—nor, indeed, in the world. His co-author on this occasion is Dr. M. T. Te Punga, Lecturer in Geology at Victoria University College, Wellington, who is now on study leave in England.

Shorter contributions have been made by: Dr. G. A. Currie, Vice-Chancellor of the University of New Zealand; Professor A. H. Clark of the University of Wisconsin; Miss Joan Metge and Mr. B. H. Farrell of Auckland University College; Mr. L. L. Pownall, Mr. W. B. Johnston and Mr. W. P. Packard of Canterbury University College; Mr. F. W. O. Jones of the Auckland Metropolitan Planning Organisation; Mr. K. G. Dobbie of the Town and Country Planning Branch of the Ministry of Works; Mr. K. Radford and Mr. R. A. Wright, schoolmasters in Auckland; Mr. T. E. French, a schoolmaster in Dunedin; and the editors.

FIRST GEOGRAPHY CONFERENCE. During the week commencing 22 August 1955 the Auckland Branch of the New Zealand Geographical Society will be host to a geography conference, the first to be sponsored by that society. After this meeting it is hoped that future similar conferences will be held at three-yearly intervals. Meetings will be held at Auckland University College and the programme will include the presentation of papers, symposia and excursions. The organisers of the conference hope to cater for all interests in geography, and the meetings will give an opportunity for professional geographers and teachers of geography to put forward and discuss their ideas. With this in mind, the programme committee would be happy to receive offers of papers on any aspects of geography from teachers working at the primary, secondary, training college or university levels, and from geographers in government service or in industry.

The programme will commence on Monday morning, 22 August, with registration and a welcome by the President of the Auckland Branch, Mr. James W. Fox. In the afternoon Professor Kenneth B. Cumberland, President of the Conference, will deliver his address, and in the evening a civic reception will be held in the Town Hall. On Tuesday, Thursday and Friday, meetings will take place at the university, and for the evenings film shows or social gatherings have been arranged. On Wednesday members of the conference will be free to join an excursion or to do as they wish.

Tentatively the programme for each day will take the following form. During the morning specific papers will be read, and in the early afternoon a methodological, pedagogical or general discussion will take place in connection with the morning papers. In the late afternoon time will be allotted to group meetings and miscellaneous papers. For example, secondary school teachers might meet for discussion of a particular topic related to teaching, while a miscellaneous paper of limited interest might be delivered in another room to the remainder of the conference members.

This will be an excellent opportunity for teachers and students undertaking research projects to discuss their problems with other geographers and to present their findings during the programme. In addition the occasion will be opportune for former students and teachers to present results of individual or group work that has been carried out as part of curricular activities or from sheer interest in the subject—the continuation and expansion of a thesis topic, for example.

The first geography conference has been arranged for geographers and geography teachers. Without their support in offering papers, taking part in discussions and attendance, the conference cannot be a success. Wholehearted support will lead to the assurance that this conference will be but the first of many in which up-to-date ideas will be discussed, accounts of research presented, and geography in New Zealand progressively advanced. —BRYAN H. FARRELL

A WASTED ASSET. The loss of high-quality agricultural land to urban uses is regarded with increasing concern by those groups interested in a sensible land-use policy for the dominion. Otaki provides an example of the misuse of land, caused by urban encroachment on market-garden soils. During the years 1948-1952 some ten percent of the total market-garden land was lost to building; and there is every reason to believe that this loss will continue.

A borough of some 2500 persons, Otaki is situated fifty miles north of Wellington on the west coast, and is one of the main sources of the capital's fresh vegetable supply, for farming there is favoured with a small strip of deep rich silt which is rarely a mile in width and about three miles long. On either side of the strip lies land of much poorer quality. Unfortunately, with the exception of the settlement at Otaki Beach, the growth of Otaki borough has been confined wholly to the silt areas. Expansion is still continuing on the rich soil, while only three hundred yards from the main shopping street the poorer land lies undeveloped for housing.

A genial climate has been the main attraction to settlement in Otaki. The existing services and roading have influenced the siting of the new houses, and subdivision has been encouraged by the lifting of restrictions on land sales and by the difficulty which market gardeners have had in obtaining sufficient labour. The increased population has required more facilities, and Otaki Railway, the settlement near the station and away from the beach, has grown since 1951 from a place consisting of a few tea-shops and garages to a large shopping centre. Future growth of the settlement has been considered, too, and a new district high school is to be built—on thirteen and a half acres of good market garden land!

It is very important to realise that about half of the new houses built have been occupied by retired or semiretired people, and the rest by young married couples, mostly business and trades people. It may be necessary and convenient for a grower to reside on the land that produces his vegetables, but the livelihood of these last two groups is generally unaffected by the quality of the land on which they build their homes. Under an imaginative land policy they could have been persuaded to use second-grade land. Thus valuable first-grade land is being taken up for housing, and the new residents are not agriculturalists.

The situation at Otaki is not exceptional. Urban encroachment on irreplaceably valuable land can be seen about Auckland, Palmerston North and Hastings and other centres. Such good land has a limited extent in New Zealand, and though it is possible to use other land for vegetables, to do so will entail greater costs. There is mounting concern at this loss of land, especially in face of the needs of the approaching third million of population. But all discussion is vitiated by the absence of an accurate and general survey of the situation.

Many people point to the need for planning in respect of this encroachment. They often fail to appreciate that the term 'planning' covers two different aspects: land-use planning of particular areas, and the type of planning which is concerned with resource patterns and their utilisation. Land-use planning is fundamentally dependent on the general principles derived from resource planning, and both types are dependent on good and accurate surveys. A survey would not only reveal basic causes and possible solutions but it could be used as an instrument of education, for public apathy draws its strength from the vagueness of 'expert' prognostications. The need for a national survey has been obvious for a long time. Of all the bodies interested, which will assume the responsibility for the survey—the Department of Agriculture, the Town and Country Planning Section of the Ministry of Works, the Soil Bureau, the Regional Planning Authorities acting together, or the Royal New Zealand Institute of Horticulture? Geographers themselves have more than once pointed to the impending dangers, but officialdom still fritters away its opportunities.

—HARVEY FRANKLIN

MAORI AFFAIRS. The reports of the Board of Maori Affairs and of the Secretary, Department of Maori Affairs, for the year ended 31 March 1954, are of particular importance from a theoretical as well as a practical point of view since a greater effort has been made than in previous years to describe the fundamental principles underlying Maori administration, in addition to the usual report on the achievements of the past year. The present aims and objects of the department are briefly stated, the specific task being defined as that of dealing with 'special problems caused by culture differences between Maori and Pakeha—differences in attitude to social relationships, to land, to money and to work, which still place many Maoris in situations of particular difficulty in a predominantly Pakeha world. . . . This Department has a duty to assist in promoting the entry of Maoris into every field of endeavour to which they may be attracted and for which they may yet need special guidance. Where any element of Maori culture can be of use in advancing the Department's policy it is seized upon and every advantage made of it.'

Thus stated, the policy of the department with regard to the position of the Maori people in the New Zealand community and the place of Maori culture in the modern situation appears to steer a moderate course between the Scylla of 'protecting' the Maori from modern life and encouraging segregation, however voluntary, and the Charybdis of enforcing assimilation and conformity to the pakeha majority. The time when the need for a separate Department of Maori Affairs will no longer exist is envisaged—'when the Maori people have made the necessary personal and social adjustments demanded by the present situation and when the remaining elements of Maori culture are harmoniously integrated within the wider New Zealand patterns.' At the moment, however, the scope of the department's activities seems to be widening rather than diminishing; the brief history of the department included in the introduction points out how land development and settlement, housing and social work have been developed in the last twenty-five years with a consequent expansion of staff and responsibilities.

An interesting section on Trusts, Titles and Claims points out that in years gone by the main expedients for the improvement of titles of Maori land have been partition, consolidation and incorporation, but that the recent increase in the size of the Maori population has rendered them inadequate. It is a pity that more space could not have been given to the present methods of dealing with this situation and the recent land legislation contained in the Maori Affairs Act of 1953. This controversial issue is hardly mentioned.

The Maori land development and settlement schemes which have been in operation for twenty-five years have undoubtedly been a great achievement for the department which is gradually succeeding in bringing the farms run by unit settlers under the supervision of departmental staff up to the average New Zealand level. In all, the department is at present handling 489,000 acres in various stages between gazetting and final disposal, and 287,000 acres in stations under its direct control. There is every justice in the claim made in the report that the present drift to the cities would have been increased tenfold, creating a social problem of far greater proportions, if it had not been for the development schemes. The new development operations in the pumice country of the Central Plateau have been the most spectacular in recent years, but the department is increasing its activities in Northland and the Waikato King Country where population pressure is so much greater.

The record of achievement in the field of building is also impressive, the construction of houses exceeding last year's peak total by fifty-five and the construction of houses for ownership by individual Maoris reaching a new record level. The department wisely insists on maintaining the same standards as apply to the best housing built for pakehas, and it has been found that the average Maori can and does measure up to the responsibility entailed in good housing.—A. JOAN METGE

M.A. AND M.Sc. THESES. During 1954 students presented sixteen theses in part fulfilment of the requirements for masters degrees in the University of New Zealand, twelve at Auckland University College and four at Canterbury University College. Victoria University College and the University of Otago put forward no candidates for examination at this stage.

Theses presented were as follows—

From Auckland University College:

- The Southern Dormitory Towns of Auckland, W. B. Aston;
- The Prehistoric Geography of the Tamaki Isthmus, H. J. R. Brown;
- The Topographic Maps of New Zealand and its Dependent and Trust Territories, S. S. Cameron;
- A Geography of Northland's Outlying Islands, with Special Reference to the Vegetation and its Cultural Modification, G. R. Cochrane;
- A Geographical Study of the Fishing Industry of New Zealand, P. D. Dibble;
- New Zealand about 1881, R. P. Hargreaves;
- The Rural-Urban Fringe of Auckland City, D. M. Holroyd;
- The East Otago Hill Country, A Region of Elaboration, G. V. Lorimer;
- The Auckland Town-Milk Supply Area, C. J. McNeill;
- The Climates of New Zealand's Pastures, M. A. Taylor;
- A Geographical Study of New Zealand Exotic Forestry Resources and Industries, P. G. Thyne;
- The Extractive Industries of the Huntly Area, M. G. A. Wilson.

From Canterbury University College:

- The Physiography of the Upper Catchment of the Selwyn River, J. Ross;
- The Secondary and Extractive Industries of the Mataura Valley, A Study in Rural Industry, Margaret L. Johnston;
- Postwar Housing Expansion in Metropolitan Christchurch, Philippa C. Alley;
- The Seaports of the South Island of New Zealand, G. Ward.

Copies of these theses are housed in the libraries of the respective colleges.

THE SOCIETY'S MAP LIBRARY. During the past year additions to the collection of topographic maps of New Zealand have numbered twelve. In the series N.Z.M.S. 1 on the scale of 1 : 63,360 the sheets Barrier (N.30-31), Colville (N. 35-36), Thames (N.49), Kawhia (N.73), Ohura (N.100) and Tiniroto (N.106) have been published. The new maps in the series N.Z.M.S. 2 on the scale of 1 : 25,000 comprise Rerewhakaitu (N.86/1), Whakaipo Bay (N.93/9), Taupo (N.94/7), Tauhara (N.94/8), Halswell (S.84/4) and Lyttelton (S.84/5).

The ever-widening range of maps published by the Department of Lands and Survey is well shown by the miscellaneous maps that are received from time to time —the map of Marlborough Sounds on the scale of 1 : 100,000 (N.Z.M.S. 105) and the street maps of the major urban centres (N.Z.M.S. 17). Of the latter series recent publications have been the sheets covering Napier and Invercargill. A most useful addition to the maps of New Zealand is the series N.Z.M.S. 83 which embraces two maps, North Island and South Island, on the scale of 1 : 1,000,000. These maps are not part of the International Map of the World on that scale, nor do they conform to the standards laid down for that map.

Hitherto the Librarian has not been able to report the acquisition of maps from sources outside New Zealand, but now under an exchange agreement, the map library is receiving the topographic quadrangle maps published by the United States Geological Survey. The number received now totals no less than 2376, and each month more are transmitted. The New Zealand Geographical Society is indeed indebted to the United States Geological Survey for this typical example of American generosity, for nowhere else in the dominion is so complete a map coverage of the United States available for reference.

THE COVER DESIGN. The *New Zealand Geographer* enters into its second decade in new dress. The Society generally, and the editors in particular, are deeply indebted to Mr. L. P. Lee of the Computing Branch, Head Office, Department of Lands and Survey, for the work that he has put into the designing of this new cover. Academic societies are often faced with the problem of achieving notability in their journals and, at the same time, retaining dignity of appearance. In its fresh guise the *New Zealand Geographer* fulfils both requirements, appealing to the eye as well as to an appetite for knowledge; and although the crest will now be transferred to the title page of the annual volume, the hallmark of the New Zealand Geographical Society remains.

IN OUR CONTEMPORARIES

1. *In New Zealand Journals . . .*

The World through New Zealand Eyes

EXTERNAL AFFAIRS REVIEW, Vol. 1, No. 1, April 1951 to Vol. 4, No. 8, August 1954.

The telescoping of time and distance today has brought in its train many problems, none more readily appreciated by the New Zealander than that of the growing proximity of Asia. Physical isolation is today a thing of the past, and the future of the dominion lies with the world at large, for no nation can now live unto itself. Much has been written of this reorientation of New Zealand political thinking—together with the social and economic implications—and it is patent to all that the dominion is shouldering its responsibilities in the councils of the United Nations and in the Pacific and beyond as a member of the British Commonwealth.

Yet it must be admitted that often the New Zealander is not fully acquainted with the details and complexities of many problems that arise; and it is in this respect that the *External Affairs Review* meets a very real need. From an unpretentious beginning in April 1951 this journal has in four years gained stature, and today possesses a standing seldom achieved by a departmental publication which relies upon its own staff and resources. The contents are still mimeographed and the maps remain rudimentary, but contained within the fifty to sixty pages of each monthly issue is a wealth of information invaluable to the student, research worker and intelligent citizen—statements made overseas and in New Zealand on policy matters and events, articles, chronologies and comments.

Of particular interest to the political geographer are the articles, which now appear more frequently, dealing with countries and areas currently significant in world affairs. Formosa, the Middle East, Hong Kong, Indonesia, Albania and Tibet have all figured in the pages of this journal, and although the treatment has been hardly geographical and the maps have shown only names and boundaries, a useful background has been provided for politico-geographical studies. It is clear that a geographer could make an important contribution to the work of the Department of External Affairs, and, with the widening ramification of New Zealand interests, it is high time that the nature, scope and contribution of geography were fully appreciated in governmental circles. Geography no longer comprises names and locations; capital cities and boundaries no longer constitute the whole field of political geography. Geography today is an integrating, interpretative study of area, and its application to specific problems would do much to counteract the lack of balance which is apparent in present-day political thinking, if the regional articles already mentioned are any criterion.

Nevertheless the *External Affairs Review* is performing a very useful function, and all concerned with its production and publication are to be congratulated. One would wish that other government departments were as fully aware of their responsibilities to the people of New Zealand.

Stock Farming in New Zealand

FARM LIVESTOCK IN NEW ZEALAND: P. G. Stevens, *Rural Education Bulletin,* Vol. 9, Nos. 4 to 10, May to November 1954.

In this series of articles, originally six talks broadcast by Radio New Zealand, Mr. Stevens has surveyed in an entertaining and colourful fashion the developments and present characteristics of New Zealand livestock production. He first considers the difficulties which confronted early pioneers in establishing their herds and flocks, and notes that, like the majority of the settlers, the British Isles was the home of most of the breeds of livestock adopted. From a variety of breeds introduced at various times, a continued specialisation has today placed New Zealand's reliance for future prosperity on a relatively few breeds.

The different forms of the livestock industry are discussed in detail. Two articles deal with the yearly round of work on hill-country sheep farms and fat-lamb farms, the interdependence of the two in the one supplying ewe replacements and the other fattening pastures being stressed. In discussing the regional differences in sheep breeds, however, the author makes the startling statement that the Romney occurs in both the North Island and Southland since 'at the southern end of the South Island . . . the climate approximates that of the west coast of the North Island'.

In a similar way dairy farming characteristics are considered with particular reference to the daily routine on the farm. Mr. Stevens considers the position of subsidiary industries of beef production largely in relation to hill sheep and fat-lamb farming, and pigs with relation to dairying. In these industries the importance of the subsidiary industry varies inversely with the prosperity of the major industry and the economic situation as a whole. Finally attention is drawn to a number of means whereby scientists can aid the farmer in further expanding the volume and quality of livestock production.

Many secondary school teachers of geography who are unable to speak with confidence about Border Leicesters, cast-for-age ewes, or butterfat per acre will find in this series an invaluable guide to most aspects of New Zealand livestock production despite the fact that the high-country sheep farm is not separately considered. Teachers more knowledgeable on livestock farming will be pleased to have available in such a concise form the background material contained in these six short articles.

—T. E. French

Farming in Southeast Otago

FARMING IN NEW ZEALAND, CLUTHA COUNTY: J. G. Richards and A. H. Mouat, *N.Z Journal of Agriculture,* Vol. 88, No. 2, February 1954, pp. 151-160, and *ibid.,* Vol. 88, No. 3, March 1954, pp. 245-249.

Clutha County is the leading county in the Otago Land District in several aspects of agricultural and pastoral production. This two-part article on farming progress in the county is a valuable addition to the series on farming in New Zealand, particularly as this county is a representative section of southern New Zealand. It contains examples of farming activities found over much larger areas: dairying on the coastal lowlands; fat-lamb production on the downlands near Balclutha; the tussock runs of the hill country; and, in addition, the milling of native timber in the Catlins.

The article gives an interesting account of the history of the development of the district and briefly discusses surface configuration, vegetation and climate. The county is divided into three main farming regions on the basis of soil differences, and the distinctive character of each area is well presented. The northern two-fifths of the county beyond the Dunedin-Invercargill main trunk railway consists of rolling downlands and is the main farming region. This is typical Otago 'browntop' country; mixed sheep farming is characteristic, with chief sources of farm income from the sale of fat lambs, wool, store lambs, cast ewes, and surplus hoggets, small seeds (especially browntop) and cereals.

The Catlins region covers the southern third of the county. It is an area of heavier rainfall and large parts are still covered in the original native bush. From the early years of first settlement timber has been a valuable product. Farming has limited possibilities in this district of steep ridges and small valleys as most soils are poor. The landscape still has a pioneering appearance—areas of native bush and cleared land and scattered fields of sown pasture. This is well illustrated by a series of photographs accompanying the article.

Between the downlands and the Catlins bush is a region of tussock grasslands bounded to the north by the high Kaihuku Range and to the southwest by the Slopedown Range. Most of this area consists of grazing runs averaging 5000 acres. This region has the greatest potential for increased production of any part of the Clutha County and much is being done at the present time with the aid of heavy machinery.

The article concludes on an encouraging note in referring to potential production. Thirty-seven percent of the occupied land is still unimproved, and it is from the development of these 189,000 acres that the greatest increase in production from Clutha County will come. A wide variety of problems must be met, but techniques have been developed to overcome most of them and the authors consider that a forty to sixty percent increase in the numbers of breeding ewes should be possible.

—K. G. Dobbie

A Contribution to Pedagogic Methodology

GEOGRAPHY IN THE PRIMARY SCHOOL: C. M. Herbert and N. H. Whatman, *National Education*, Vol. 36, Nos. 384 to 395, February to December 1954.

Present-day teaching of geography in New Zealand primary schools is as varied as the different concepts of the content and method of the subject which have guided educational development in geography at various times during the past seventy-five years. In extreme cases, even from classroom to adjacent classroom with classes of the same stage, the variation may be noted. The deterministic approach, stemming from the 1928 syllabus, governs the method and subject matter for the one, whilst in the other the children recite place names, locate rivers, mountains and other physical features of the landscape, generalise about climate, and map in broad distribution the places of origin of agricultural products and valuable minerals. The deficiencies in the teaching of geography based on out-moded geographic thought are self-evident when the teacher pauses to investigate and understand the present approach to, and method in, the subject with its expansive opportunities for reality in teaching and learning.

Their appreciation of this problem and of the need for guidance to teachers of geography by trained geographers, have led Mr. C. M. Herbert and Mr. N. H. Whatman, each a Lecturer in Geography at Ardmore Teachers' College, to publish this series of eleven articles addressed to primary-school teachers. Their aim is to help practising teachers achieve a proper understanding of the 'new viewpoint' in geography, and in so doing convince them that it 'should be adopted as an integral part of primary school geography'. In pursuit of this aim, they discuss first the nature of geography and then its application within the bounds of the present syllabus. This philosophic introduction is followed by an assortment of pedagogical considerations under such titles as 'Introducing the Map', 'Projects', 'Visual Aids'.

In their introductory articles the authors completely expose the causal factors determining the present situation, and offer lucid, logical and convincing arguments against present failings. However, their explanation of what is good geography, because of its brevity, seems to lack the same degree of effectiveness. Nevertheless, they provide the necessary reinforcement of their claims by the skeleton sample studies of 'what places are like'.

Many fundamentals in the teaching of geography at this level appear haphazardly throughout the text of these essays: description should always precede any explanation; the necessity to avoid simplified, inaccurate causal explanation; the need for careful locating of places; and so on. It is unfortunate that these and other essentials are not emphasised by the use of a bold-face type.

The later articles which consider methods in geography in the primary school lack the convincing nature of the introductory studies. Their haphazard order tends to be bewildering. The authors sandwich an article dealing with the scope of geography between considerations on method. Secondly, one feels that in the papers on method, there remains an antithesis between theory and practice. Rather than enumerate methods peculiar to geography, such as the specific use of maps, diagrams and equipment, then illustrating practically their application, the authors propound general educational principles already familiar to most teachers. But these faults are ameliorated by an excellent 'Summing-up'.

The thinking teacher will find definite guidance in this summary. He cannot but be convinced that the ideas and principles advanced must form the basis of the approach within, and more essentially outside, his classroom. Mr. Herbert and Mr. Whatman do well to stress continually the necessity for real experience of 'what places are like'. Their starting point—the unit study—is attractive to the teacher, and, when soundly introduced to the children, provides them with an absorbing study and a sure foundation for later progress.

In few, if any, other subjects is there the same possibility or scope for individual, enterprising, interesting and valuable work at the primary-school stage as in geography. This series of articles must be commended to teachers as indicating a means to this end. The authors have helped to overcome the paucity of suitable reference material for teachers, and their work deserves the highest appreciation.

—R. A. Wright

2. *In Overseas Journals . . .*

A Contribution to Urban Geography

FUNCTIONS OF NEW ZEALAND TOWNS: L. L. Pownall, *Annals of the Association of American Geographers*, Vol. 43, No. 4, December 1953, pp. 332-350.

Mr. Pownall, in his introduction, points out that in the relatively short period of European settlement the towns of New Zealand 'have acquired a uniform and individually characterless appearance'. The truth of this statement, and the very fact of this apparent uniformity, make it all the more interesting and useful to follow the method of analysis and the resulting classification of towns in this study.

The study was based on statistics available for April 1950 and the method adopted was: (1) to base the definition of a 'town' on the statistical units used by the Government Statistician for census purposes (that is, 'urban areas', 'boroughs', 'town districts'); (ii) to divide all towns of more than 1000 population into groups of approximately the same size, resulting in 100 towns divided into seven groups—Group I containing four towns between 90,000 and 308,000 people, to Group VII containing thirty-six towns of between 1000 and 2000 people; (iii) to calculate national means (for each group of towns) for six different types of employment (which cover practically all gainful employment) and derive means for residential function (for each group); (iv) to measure, for each individual town, the deviations in occupational structure from the national means for the particular group, and thus derive that town's function, or functions; (v) to show diagrammatically on a base map of New Zealand, the location of the 100 towns and their functions as derived above; (vi) to set out, in a series of seven maps, towns of different primary functions (i.e. 'residential', 'manufacturing', 'primary industry', 'transport', 'distribution and finance', 'hotel and personal service', 'administration and professional' towns).

In a study of this nature certain basic assumptions and arbitrary subdivisions cannot be avoided. A limitation is imposed by both the statistics and the statistical units available. Within the limits of the information available in New Zealand, it does not seem possible to arrive at a better method of analysis and classification than that used by Mr. Pownall.

However, any interpretation of the results of this study must be made with care, and the method adopted must be kept in mind all the time. Unless this is done, the results could be deceptive. For example, Papatoetoe, Manurewa and Howick are suburban areas of Auckland, but because they were, in 1950, statistical areas of the Census Department separate from the Auckland urban area, they become grouped with towns such as Stratford, Dannevirke and Wairoa. The author refers to towns such as Papatoetoe and Manurewa as being 'dormitory towns', but it might have been preferable to have included them with the Auckland urban area—the national means for the remaining towns in the corresponding population group might then have been more real.

The most practical method of classifying the towns according to function is, undoubtedly, that used in this study—that is, by analysing the occupational structure of each town—but it is unfortunate that the port function of some centres is thereby excluded (partly because the employment returns of the Labour Department do not include port workers). The main difficulty in this method of analysis appears to arise out of the need to group towns of approximately the same size and consider their functions in terms of deviations from the means for that group. For example, the four main centres comprise one group of towns, and the function of any one of these centres is shown relative to the other three—but not relative to the country as a whole. Possible anomalies arising out of this method of analysis can be illustrated by a hypothetical (and extreme) example:

> If, for example, all the manufacturing industry in New Zealand was located in the four main centres and was distributed between them approximately in proportion to their populations, none of the centres would appear as having a 'manufacturing function', whereas, in actual practice, in that case, the largest centre would contain between 40 and 50 per cent of the total manufacturing industry in the country, and a very large proportion of its population would be engaged in that industry.

The importance and effect of this aspect would merit some investigation by any student using this analysis as a basis for further work.

Mr. Pownall's study has broken new ground in studies of urban geography in New Zealand, and provides the most comprehensive examination of our towns ever undertaken. The wealth and range of material presented is such that it can be barely touched on in a short review. It provides a broad and sound basis for further work on the geography of New Zealand towns. One would, perhaps, like to see an analysis carried out of towns in the future in relation to geographic regions of New Zealand.—F. W. O. Jones

A Chapter of Historical Geography

'JIMMY GRANTS' AND 'MIHANERES': NEW ZEALAND ABOUT 1853: Kenneth B. Cumberland, *Economic Geography*, Vol. 30, No. 1, January 1954, pp. 70-89.

The first thing to observe about this article is that the author obviously greatly enjoyed writing it and that it must be a dull dog of a reader, indeed, who will not enjoy reading it. A great deal has been written about the importance of studies of historical geography as essential underpinning for contemporary analyses. Although such sentiments are unexceptionable, and could be supported readily by reference to this study, what it illustrates most vividly, perhaps, is that the digging for, and writing of historical geography is great fun. And it reminds those of us who are pedagogues that there are few better kinds of writing to put in the hands of students if we would enlist their enthusiastic interest in any sort of geography of an area.

For some years Professor Cumberland has made the historical geography of New Zealand one of his major interests. He has already contributed articles in the *Geographical Review* on the pre-European geography of the area and in the *New Zealand Geographer* on the initial stages of European exploitation—'spoilation' as he termed it and as, in considerable measure, it was.

In this third article of the series Dr. Cumberland carries the story through the annexation of the islands by the British Crown and the first dozen or so years of organised (and locally most disorganised) settlement. As he points out, this was not so much a period of transformation of the landscape as 'a change in the methods and aims of pakeha settlement and institutions—a change that in the succeeding century (and especially the first half of it) was to make possible and to bring about a wholesale transformation of the New Zealand countryside'.

Besides a detailed historico-geographical description of the country over a period of a dozen years he makes a bold, and conspicuously successful, attempt to outline and describe the regions of New Zealand in 1853: The European oekumene (Auckland and the North Auckland Peninsula; the Cook Strait borderlands—Wanganui, Wellington and Nelson; Christchurch, Akaroa and the nearby Canterbury Plains; and an eighty-mile stretch of the Otago coast centred on Dunedin), the Maori-dominated interior and east coast of the North Island and the huge, empty interior and west coast of the South Island. It is a long chapter, fascinatingly written and well illustrated with numerous reproductions of contemporary engravings and skilfully-planned maps.

One may perhaps cavil at the title, involving a heavily laboured pun (albeit in wide local use at that time) and the use of a name for the converted Maori who are hardly as important to the story as a joint place in the title would indicate. To an outsider, even one familiar with the country's history and topography of the period, there are excesses of place names not located on maps, of other terms like 'mihaneres', and of localisms in general. But these are small defects in this splendid series. We are fortunate indeed that one so knowledgeable of the landscape and economy of the country, and with such an affection for its rich documentary and early written historical sources, and possessing such skill in using them, has undertaken the definitive historical geography of his adopted country. May nothing prevent the completion of this vital task!—A. H. Clark

A New Zealand Pot-Pourri

NEW ZEALAND, *Pacific Discovery*, Vol. VII, No. 4, 1954.

Several New Zealanders have contributed short articles to this special issue of *Pacific Discovery*, the purpose of which was 'to arouse curiosity about New Zealand' primarily among American readers. To this end one or two facets of contemporary and early New Zealand have been described.

R. A. Falla writes of the native fauna; W. H. Dawbin contributes an interesting account of whaling by Maoris—a phase of whaling that has been closed for the past twenty years; and Derisely F. Hobbs presents a brief account of the Maori as a conservationist in the past. The gannets of Cape Kidnappers are described by R. T. Wearne; V. J. Chapman makes another plea for the conservation of Waipoua Forest, and in so doing reviews briefly the edaphic conditions of the kauri, and outlines the economic uses of this tree in the past. On the volcanic belt of the North Island, G. C. Shaw gives a rapid survey of the Volcanic Plateau and its volcanoes, dwelling at some length on the Tarawera eruption; while D. W. McKenzie sets out in the briefest of precis forms the structural elements of the country as a whole.

There is no theme or unity to the publication. The writers make no claim to serious treatment; as a result the journal is very light and very easily read. The photographs are uniformly excellent and are a real contribution. Even here the accent is placed on the past and on the role of the Maori. The solitary map is extremely disappointing. —L. L. Pownall

REVIEWS

A Geography of the Australia-New Zealand Region

SOUTHWEST PACIFIC. Kenneth B. Cumberland. Christchurch: Whitcombe and Tombs Ltd., 1954, pp. 365.

It is a far cry from the kind of geography some of us learned at school with its lists of towns, rivers, imports, exports, rainfall statistics and other factual material unrelieved by any connecting matrix, to this interesting and information-packed book by Professor Cumberland about the Southwest Pacific region. He has dealt with the countries in the area, Australia, New Zealand and the Islands, in the broadest possible way, expressing the historical, physical, climatic, anthropological, statistical, economic and political aspects in the entirely modern geographical manner so that it can be read and enjoyed by any intelligent upper school boy or girl. But perhaps the book is equally well, if not better, suited to the interested adult layman.

There is, I am told, no other comprehensive single geography book wholly devoted to this region. I enjoyed reading it all the more because I was constantly able to test what I knew about the countries concerned against the wealth of information in the book. The information stood the test of personal knowledge and added greatly to it. The strenuous years since Cook's day have brought developments here recorded which are very remarkable in such a short period.

The story as told by Dr. Cumberland retains the romance but gives the impressive facts which are needed for true perspective and understanding, and includes interpretations which relate the existing facts to the geographical setting. The material used is thoroughly up to date, and the most recent advances made in our knowledge of climatic phenomena, soils and their treatment, peoples and processes have been used in the book with a fresh interpretative comprehensiveness which is one of its best features.

It is quite easy to point minor omissions in some of the statements in a text containing such a mass of information. For instance, in commenting on the myxomatosis in rabbits (p. 76) the virus is described as being 'carried by stickfast fleas', but this omits the importance in Australia of mosquitoes and sand flies as vectors. A map (p. 106) showing the coal areas of Australia is somewhat hard to interpret and shows no brown coal in Victoria, although there is an excellent photograph of the brown-coal open-cut at Yallourn in Victoria seven pages further on. To a purist in English the statement (p. 94) that 'efforts should be made *both* by local, State and Commonwealth authorities . . .' might cause the raising of an eyebrow, but these are really minor matters in a book full of well-selected reliable geographical material.

The Australian and New Zealand parts are naturally most extensive, but the Pacific Islands are given fair and reasonable treatment. There is a good early description of the physical structure of the whole Pacific basin, including the story of the Marshall line, and in a section devoted to the Islands there is a good account of the theory of origin of coral reefs and atolls which is always intriguing. Like the Australian and New Zealand sections the physical, climatic and anthropological information about the Islands is given along with the commercial and political situation as it obtains today. The whole gives a much needed factual background for a real understanding of our Pacific neighbours.

The maps, statistical tables and diagrams are many and excellent; there can never be too many of these in such a work. The photographs are good, but, to my way of thinking, less necessary in these days of documentary films and travel talks than they used to be. However, I suspect that most readers would not agree and would prefer not to cut down on interesting illustrations. The book is a handy size, well printed and easily read. —G. A. CURRIE

AD AUGUSTISSIMA

THE ASCENT OF EVEREST. By John Hunt. London: Hodder and Stoughton, 1953, pp. 299.

Sir John Hunt's account of the successful 1953 climb of Mount Everest has probably been read by most people at all likely so to do, and a review of it now might therefore seem superfluous. However, the time which has passed since the book's publication and the event itself enables us to see the ultimate ascent of the world's highest mountain in a better perspective. Fuller descriptions of other nations' postwar Himalayan ventures have now come to hand and permit a wider and therefore safer basis of criticism.

Time has in no way reduced the size of the British party's achievement. That this is so is due in part to the quiet modesty of the team faced with public acclamation and temporary adulation. Much, however, is due to the nature of this, their official account. Sir John Hunt has written a very British book. Restrained, precise, and thoroughly well organised and illustrated, it tells a plain unvarnished tale, and is all the more gripping as a result. Though written within a month, it is coherent and well phrased; though restrained, it is neither dull nor unemotional. A great benefit is that the book conveys to the non-mountaineer (who, like the uninitiated reading of any sport, frequently feels lost) something of the meaning of Everest to the party climbing, as well as the nature of the technical problems involved.

The enormous achievement of the Everest team, however, lies not so much in a logistical appraisal of the mountain, nor in a massing of men and materials at the right time, nor in solving the physiological problems involved. Now it can be seen to lie in imprecise and unfathomable human qualities found only in a team. What shows most clearly in the account, particularly when it is read against other recent ventures in the Himalaya, is the superb leadership of Sir John and an equally outstanding response from the entire team. This was their real conquest—not of the mountain, but of themselves. Happily, however, these winners of the 'Third Pole' had so organised themselves that they came back unscathed. Success was unmarred.

This book then is an adventure, but an adventure which should make special claims on the geographer. The popular tradition which equated geography with exploration has been rightly repudiated, and as an academic discipline, geography draws its substance from far more scholarly and substantial stuff than the haphazard findings of travellers and explorers. However, the support of a world-wide range of exploratory ventures has long been the happy task of the principal geographical societies in the northern hemisphere. Throughout the history of attempts on Everest, the part played by the Royal Geographical Society has been as great as that of the associated, but purely mountaineering, society of the Alpine Club. An exploratory urge is vital to geography. True, at its worst it leads to 'otherwhere-itis' which, as has been said, 'is a peril to the wellbeing of geography'. But if a principal task of our subject is the study of place, then rightly we will at certain times be explorers abroad as well as at home.

The Ascent of Everest is in every way worthy of the great achievement it tells. It is a story to be read, and it will be reread.—W. P. Packard

The Near North

ASIA, EAST BY SOUTH: A CULTURAL GEOGRAPHY. By J. E. Spencer. New York: Wiley and Sons, Inc., 1954, pp. 453.

This is a major work offering a new approach to the geography of Monsoon Asia —essentially a geography of the different cultures that have evolved in the particular environments in the realm reviewed. Dr. Spencer, now Head of the Department of Geography in the University of California, Los Angeles, is unusually well-equipped for his task by virtue of long experience of the Orient. The book is large, both in page size and number, with no photographs, but is lavishly illustrated by clearly-drawn maps, and is very readable in its style.

Occupying about a third of the work, the first part provides the systematic background essential to an appreciation of the local settings for the development of the cultures of the Orient. In order to preserve a broad canvas, the author employs a somewhat simplified approach and never becomes highly technical. Surface configuration, one feels in the early chapters is not Dr. Spencer's *forte,* in spite of its lengthy treatment; climatology is considered mainly in terms of sensible climate, with new maps of comfort zones, drought areas and flood regions though precise bases for the two latter are lacking. No discussion of climates on regional lines follows the material on temperature patterns and precipitation regimes, and four full-page maps of well-known climatic schemes as applied to Monsoon Asia are simply offered without comment, except to say that none is entirely satisfactory. Chapters that follow open up new and interesting fields in respect of marine life and animals in oriental economy, on the geography of health and disease, on settlements and their architecture, on peoples and their languages, and on religion, law and the social orders. Regional contrasts in each of these chapters are frequently pointed out, but the treatment lacks precision, and the comments on local conditions are all too few. There is a complete absence of detailed local examples and sketch maps.

The second part is Dr. Spencer's real contribution, and is frankly inspired by Sauer's teaching, in that the abundant material concerned with the past is not considered essentially distinct from an interpretation of the present, and is all part of the genetic approach—the search for origins through a study of development. The unit of study is in almost all cases the political state, except that the chapters on 'Mother India' include Pakistan in view of the long history of inseparable development.

Dr. Spencer presents the current political, social and economic scene against the centuries of occupance that have gone to produce the contemporary situation, and one gets the impression that he is inviting the West to take the long-term view, believing that the Orient has often demonstrated its ability slowly to absorb and digest innovations that are offered it, and that ultimately it has reformulated its own ways of life in an inexorable process of adaptation to meet changing circumstances. The notable exception is the history of Japan, with several closely similar periods of planned overhaul and cultural change, but Dr. Spencer sees in these rapidly carried-out transformations, something peculiarly Japanese, and no slavish copying of economic or social forms.

All references are given at the end of the book, grouped under chapter headings in a bibliography of about 800 titles, but there is no system of specific reference to any particular work. An appendix deals with useful statistical material in standard form for each country, and a place-name index is given separately. This fascinating book, appearing at a time when New Zealand's fortunes are being more definitely linked with Monsoon Asia than ever before, will interest a wider group of scholars than geographers. It is no substitute for a textbook of regional geography and many of its comments leave one with a feeling of regret that it has not been possible to include more firm facts and precise field evidence.—R. G. LISTER

A HISTORY AND GEOGRAPHY OF CANTERBURY

PENINSULA AND PLAIN. Christchurch: Whitcombe and Tombs, Ltd., 1955, pp. 56.

'Those members of the staff of Christchurch Boys' High School who teach history and geography' have written a sixty-page history and geography of the home region —that is, of the Canterbury Plains, Banks Peninsula and the Christchurch metropolitan area—which could usefully be emulated and improved upon by the masters (or mistresses) of at least twenty other strategically-located schools in New Zealand. It is a good start. But its successors could well be better.

Unfortunately the history and geography masters at the Christchurch Boys' High School do not work well together, judging by their respective contributions. History is as essential to geography as geography is to history, but to place them side by side is not enough. To introduce a history with a separate and apparently unconnected physical geography is as unsatisfactory as it is to precede a purely descriptive essay on the contemporary 'landscape' with a discrete and detached historical introduction which narrates a succession of geographically irrelevant facts and events. To say this is not to appeal for the begetting of a 'social-studies' mongrel. It suggests rather, if historians and geographers do not cooperate satisfactorily, then two thirty-page essays might be better: a social history with such geography (if any) as the history masters find necessary to interpret their factual narrative; and an interpretative geography provided with such history (and material from many other disciplines) as geography masters have come to find essential to bring the 'landscape' alive, to interpret its individuality and to explain how it functions. Pupils still have enquiring minds if they are not too soon stuffed with undigested facts.

The very limited and often facile interpretation and generalisation in this little book is well illustrated by one example. Towards the end of a three-page, straightforward factual account of 'The Metropolitan Area' one finds this: 'Christchurch, then . . .

is characterised by its low skyline—a product of its flat site.' If the recital of facts has not dulled his mind, the pupil will want to know why Chicago, lower Manhattan, St. Louis and so many other cities with equally flat sites do not have low skylines. He might even have courage to suggest that building by-laws, swamp foundations, earthquakes, shortage of financial capital, Christchurch conservatism, and so on, may perhaps in this case be as significant as flatness of site.

Except perhaps at the Christchurch Boys' High School, the geography in *Peninsula and Plain* will not replace the appropriate *Post-Primary School Bulletin;* and the local history could have been done much better. But still here is a good idea—an idea that should appeal to other school staffs. Here is a booklet that could have been better —a booklet that could have served a most useful purpose. If others take up the idea they might usefully restrict their areal coverage. The local region could with profit be more narrowly defined than is the case here. And if other like booklets are intended to be used in schools, they could well have a cover and binding that will stand some wear.

A World Geography for New Zealand Schools

THE WORLD: A GENERAL REGIONAL GEOGRAPHY. By J. H. Stembridge, R. B. Withers and B. J. Garnier. London: Oxford University Press, 1952, pp. 583.

At first glance this appears to be a new geography, the work of a group of authors. It is, however, a new edition of a well-known work by Stembridge with the sections on Australia and New Zealand completely rewritten. The book is designed to cover requirements of the public examination board of some universities of Australia, the New South Wales Department of Education, and similar bodies in New Zealand.

The most important change from the previous edition is the inclusion of a completely new and much larger Australian section, consisting of one general chapter and four chapters on regional geography. The first chapter deals systematically with the main physical and cultural elements, and is well illustrated by maps of soils, vegetation, crops, stock, timber resources and mining. Other valuable maps are those illustrating the length of the growing season, using P/E ratios, and the irrigation systems of the southeast. Regionally, Australia is divided into four physiographic regions, each subdivided on the basis of climate. The resultant pattern agrees fairly well with the commonly-defined geographic regions. In all, the Australian section of this book compresses into a small space more useful material than is readily available elsewhere.

The New Zealand section is much smaller, but is of value as an introduction to the geography of the country. The section comprises two chapters, the treatment of which tends to be hackneyed, although in parts it does break away from a purely factual account into some brief but vivid descriptions of landscape. Mr. Garnier has attempted a regional division, postulating four North Island and six South Island regions. This division fulfils the author's purpose, but teachers may question the virtue of telescoping Northland and South Auckland into one region, Northern New Zealand.

Despite some small errors of fact, both the Australian and the New Zealand sections are valuable contributions, the former especially. The maps are detailed, clear and informative, although they do not conform with the sketch map technique adopted elsewhere in the book.

The remainder of the book is almost identical, in text, maps and illustrations, with the edition revised in 1950, except that the British Isles is reduced from seventy to thirty-three pages. Map projections have been omitted altogether, and a few new questions are added. The paper is better and the maps clearer. All the outstanding photographs of the earlier book remain.

As a world geography, the book lacks balance, but for New Zealand readers it has gained materially, and the full treatment of Australia more than compensates for the few reductions elsewhere.—K. B. Radford

An Essential Textbook

ECONOMIC GEOGRAPHY By C. F. Jones and G. G. Darkenwald. New York: The Macmillan Company, 1954 (Revised edition), pp. 612.

The first edition of *Economic Geography* was published in May 1941. Within thirteen years more than ten reprints have been made, and this in itself is indicative of the value of the book. The publishers are to be congratulated in producing a *Statistical Supplement* to accompany the twelfth reprint in 1950. The latter fact underlines one of the greatest problems facing writers of economic geography—that of annual statistics. It is pleasing to welcome, therefore, a thorough revision of the book. The original organisation of material has withstood the test of time and, as is stated in the preface to the revised edition, '. . . the basic patterns of the types of activities or industries of economic geography . . . are today essentially the same as they were before World War II'. Thus, those who have already used this book will find the new edition in the form of an old friend.

There are however important additions and improvements. The greatly-increased significance of the chemical industry is illustrated by a new chapter written by a specialist, Donald R. Petterson. The chapter on automobile and aircraft industries is considerably enlarged. These are major changes. In addition a wide range of maps has been redrawn, new ones included and some omitted. Many of the photographs have also been changed. Three further features are noteworthy. To many users, the standard of some maps was poor in the original edition and it is pleasing to see these important defects removed. Secondly, the improved quality of paper has resulted in clearer reproduction throughout. Finally, the selected bibliographies at the end of each chapter have been brought up to date.

The authors and publishers will be amply rewarded for their labours by the new lease of life given to one of the few good textbooks in the field of economic geography.
—W. B. Johnston

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